Anchor Bay
Watershed Management Plan
2006

April 2006

Acknowledgements

Participating Communities:
City of Algonac
Chesterfield Township
Clay Township
Clinton Township
Cottrellville Township
China Township
Casco Township
Harrison Township
Ira Township
Lenox Township
Macomb County
Macomb Township
City of Marine City
City of Mount Clemens
City of New Baltimore
Village of New Haven
City of Richmond
Richmond Township
St. Clair County

St. Clair River Flats

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Michigan's Nonpoint Source Program

ANCHOR BAY

WATERSHED MANAGEMENT PLAN

APRIL 2006
PROJECT NO. G04211

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CHAPTER 1 - STATE OF THE ANCHOR BAY WATERSHED

1.0 ANCHOR BAY WATERSHED OVERVIEW

The original Anchor Bay Watershed Management Plan (WMP) provided a comprehensive overview of the characteristics of the Anchor Bay Watershed (Watershed).

1.01 LOCATION

The Watershed is part of the Lake St. Clair Drainage System and provides recreation and aesthetic beauty to residents of Macomb and St. Clair Counties, as well as many visitors from throughout the United States and Canada (Figure 1-1). The Watershed encompasses 171 square miles (443 km2), including the Delta islands (Harsens and Dickinson islands), in Macomb and St. Clair Counties. In St. Clair County, the Watershed includes all or part of Casco, China, Clay, Cottrellville, and Ira Townships, and the Cities of Algonac and Marine City. In Macomb County, the Watershed includes all of the City of New Baltimore and parts of Chesterfield, Clinton, Harrison, Lenox, Macomb, and Richmond Townships, the Village of New Haven, and the Cities of Mt. Clemens and Richmond. Major tributary streams within the Watershed include Auvase Creek, Beaubien Creek, Crapau Creek, Marsac Creek, Swan Creek, the Marine City Drain, the Salt River, and all contributing drains (Figure 1-2).

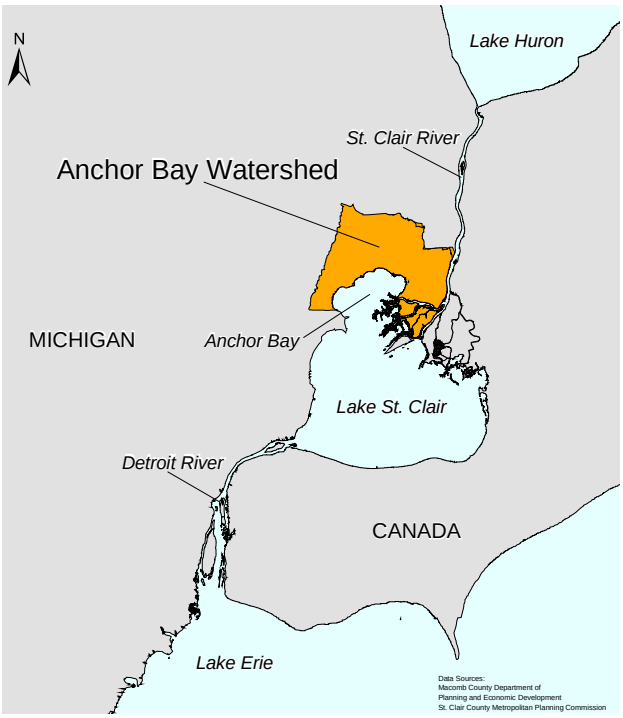

Figure 1-1: Location of the Watershed within the Great Lakes

1.02 HYDROLOGY

The Watershed contains 473 miles of waterways, including 104 miles of drains in agricultural areas. The majority of the flow into Anchor Bay comes from the north channel of the St. Clair River, from the northeast. Depending on wind conditions, flow from the middle channel, to the southeast can also enter Anchor Bay. Under certain climatic conditions, flow enters the bay from Clinton River, to the south. The specific residence time in Anchor Bay will fluctuate depending on the circulation patterns, which vary according to the dominant wind and current. Information pertaining specifically to the Anchor Bay hydrology is included in Section 1.1.4.4 of this chapter.

Additional studies and modeling were conducted to update this WMP to provide accurate information regarding flow patterns into the bay under various climatic conditions.

1.03 TOPOGRAPHY AND SOILS

Topography of the Watershed varies from level to gently sloping terrain. The majority of the Watershed is characterized as lake plain with some limited glacial till in Macomb County. Although there is a limited area of sandy soil within the Watershed, the soils are generally characterized as poorly drained with high clay content.

1.04 HISTORY OF THE WATERSHED

Lower reaches of the St. Clair River and Lake St. Clair generally remained unaltered until about 1900. The U.S. portion of the St. Clair basin, including Anchor Bay, was initially settled because the St. Clair River and Lake St. Clair provided numerous resources, including a transportation corridor and an abundance of fish and wildlife. Throughout the 1800s, settlers changed the land from primarily deciduous forests and lakeplain prairies into land cleared for agriculture. The lake and river continued to serve as an important regional transportation corridor. In the late 1800s, two significant developments occurred that led to rapid alterations in land-use patterns: 1) passage of the federal Swamplands Act of 1850, and 2) introduction of new technology that vastly improved transportation.

For many years, access to the land was limited by the very nature of the property. In 1815, the U.S. Surveyor General reported that a large part of southeastern Michigan was a swamp and practically worthless. As a result, the Swamplands Act of 1850 provided swampland to individuals at no cost if they agreed to drain the land and develop it into a useful parcel. This law stimulated settlers to drain and fill vast areas of wetlands along the St. Clair River and Lake St. Clair. By 1873, the land between the Detroit and Clinton Rivers and Anchor Bay had been almost entirely converted to agriculture.

In turn, improved transportation made drained land more accessible. The advent of electric and steam railways, along with a dredged shipping channel through Lake St. Clair, led to an increased human population, multiple private and public recreational activities, and industrial development along the St. Clair River.

Development, particularly on the Michigan shoreline, intensified in the 1950s, and by the mid-1970s, much of Michigan's Lake St. Clair shoreline was fully developed.

To date, Anchor Bay's recuperative powers have exceeded man's ability to inflict harm. The rapid development of the Lake St. Clair shoreline stressed the ecosystem, but the lake proved to be resilient. Because much of the drainage area contributing to Anchor Bay remained undeveloped into the 1980s, the assimilative capacity of the contributing streams and the nearshore waters helped the habitat remain

intact. However, recent nearshore algae blooms and beach closings suggest that this capacity is now being tested.

1.05 RECREATIONAL OPPORTUNITIES

Many people choose to live in southern St. Clair and eastern Macomb Counties because recreational opportunities presented by Lake St. Clair add quality to their lives and value to their property. These recreational opportunities include:

- Boating, swimming, and fishing, including wintertime ice fishing.
- Hunting (Anchor Bay is one of southeast Michigan's premiere duck hunting areas.)
- Walking and bicycling along the Bridge to Bay Trail in St. Clair County and the Macomb Orchard Trail in Macomb County. (Plans are being discussed to link these trails.)
- Points of interest, such as Cherry Beach dock in Cottrellville Township; Selfridge Air National Guard Base in Harrison Township; Algonac State Park; St. Clair Flats State Wildlife Area in Clay Township; Ira Township Park; Boat Launch in Chesterfield Township; Brandenburg Park along the bay and Pollard Park Nature Area on the Salt River in Chesterfield Township; and New Baltimore Beach and St. Johns Marsh in Clay and Ira Townships.

Because of these recreational opportunities, the health of Lake St. Clair and Anchor Bay is of tremendous importance to area residents. In many ways, Anchor Bay's water quality is quite good. Ongoing development, however, continues to negatively impact these resources.

1.06 FISH AND WILDLIFE HABITAT

The Watershed contains approximately 38,000 acres of ecologically sensitive land. Various wetland types include open-water wetlands, beach and shoreline wetlands, cattail wetlands, sedge wetlands, abandoned channel wetlands, wet meadow wetlands, and shrub wetlands (Figure 1-3).

Wetlands are critical if diverse populations of fish and wildlife unique to the area are to be preserved.

St. Johns Marsh is one of the largest coastal wetlands in the Great Lakes. This 2,500-acre marsh in Clay and Ira

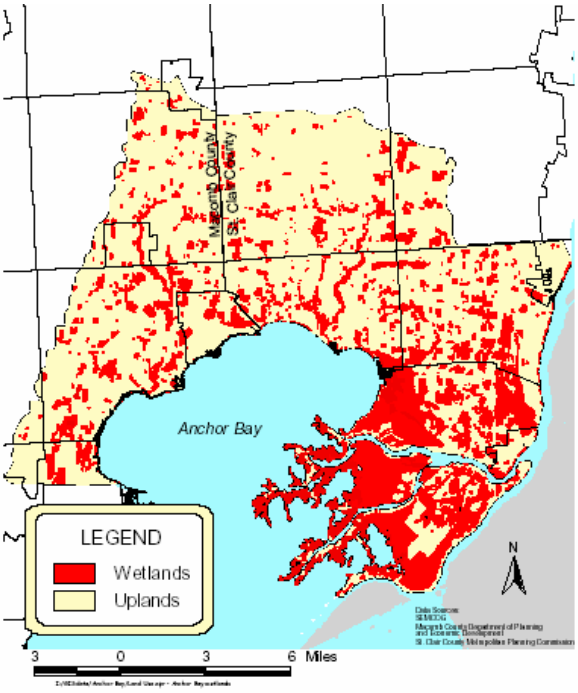

Figure 1-3: Anchor Bay Watershed Wetland Areas

Townships is within three-quarter miles of the lakeshore and is directly influenced by water level changes in the bay. Compared to inland wetlands, coastal wetlands are more dynamic, display a greater diversity of landforms, and are less influenced by groundwater inflow. It is currently home to rare and endangered plants and wildlife, including fox snakes, and prairie-fringed orchids and birds, such as the king rail.

The diverse fish and wildlife species that inhabit Anchor Bay require more than simply a pollutant-free environment. They are dependent on the diverse food web that supports larger animals upon which many sport recreational opportunities depend. At least 12 varieties of submerged plants in Anchor Bay provide an excellent habitat for waterfowl and 117 fish species that are either permanent residents or enter the system from Lake Huron and Lake Erie to spawn. Anchor Bay has one of the highest densities of fish flies in the St. Clair-Detroit River System. Fish flies, although sometimes viewed as a nuisance, provide food for fish and wildlife and are indicators of a healthy water body because they are intolerant of pollution. The fish fly larvae is just one of the 300 species of bugs, known as benthic macroinvertebrates, which live on or in the bottom of Anchor Bay. These bottom-dwelling plants and animals are the food source for larger sport fish and animals.

1.07 LAND USE

Land use in a watershed has a direct impact on the water quality, which, in turn, affects the health of ecological diversity in the aquatic system. Between 1990 and 2000, the land use trend leaned toward an increase in residential, commercial, and industrial areas, resulting in a decrease of woodlands, wetlands, cultivated grasslands, and shrub areas (Figures 1-4 and 1-5). This trend is predicted to continue. The Southeast Michigan Council of Governments (SEMCOG) forecasts that the Watershed population will increase 40% and households will increase by almost 58% between 2000 and 2030. The anticipated increase in impervious area and decrease in areas that provide natural treatment and reduction for such things as storm water runoff will tend to increase harmful impacts on the watercourses with respect to sediment, nutrients, bacteria, and chemical contaminants. This development trend will also decrease available habitat for fish and wildlife, increasing stress on the limited remaining natural habitat.

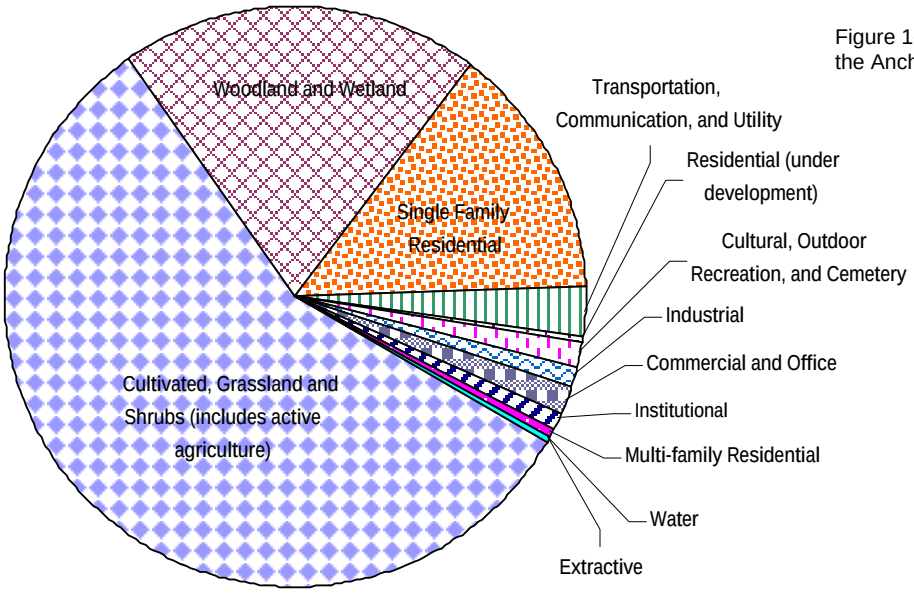

Figure 1-4: 1990 Land Use for the Anchor Bay Watershed

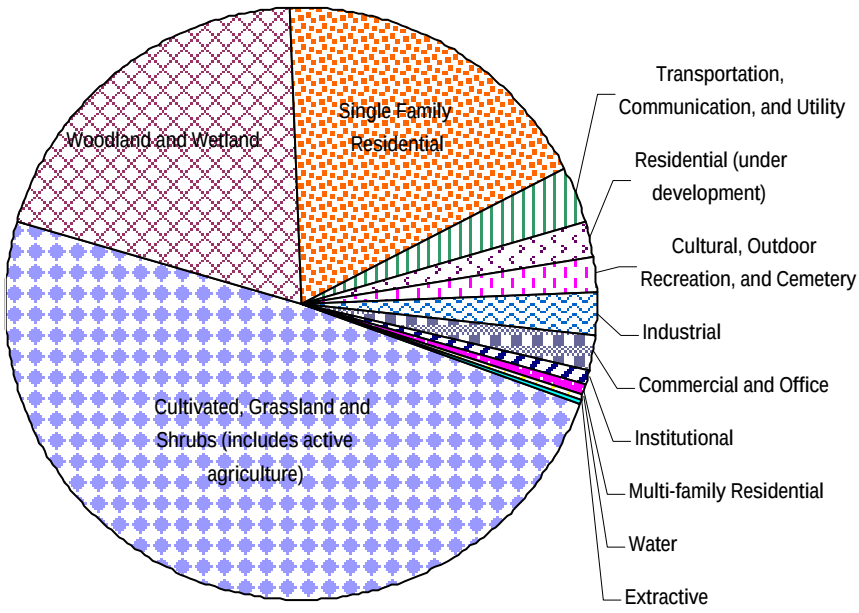

Figure 1-5: 2000 Land Use for the Anchor Bay Watershed

1.1 ANCHOR BAY POLLUTANTS, SOURCES, AND MONITORING DATA

The major stresses, such as reduced habitat, increased contamination of habitat, elevated bacteria concentrations at beaches, limited public access, and increasing numbers of invasive species, are now generally associated with residential development and human impact, rather than industrial activities.

The pollutants that once discharged from industrial outfalls are now controlled, but pollutants associated with construction, residential, and recreational activities continue to challenge Anchor Bay's natural recuperative powers.

1.11 WASTEWATER AND INDUSTRIAL DISCHARGES

Since the onset of environmental laws, a great deal of effort has gone into controlling pollutants associated with wastewater and industrial discharges, which are regulated under permits issued by the Michigan Department of Environmental Quality (MDEQ). This program has been in place since the early 1960s and continues to be an effective mechanism for environmental control. Sixteen permitted point source discharges exist within the Watershed (Table 1-1), as indicated in the list provided by MDEQ at http://www.deq.state.mi.us/documents/deq-swq-npdes-prmtlist.xls (last updated March 9, 2005). The vast majority of these are treated domestic wastewater discharges from municipalities or private developments, schools, and highway rest areas. MDEQ personnel have indicated that permittees within the Watershed are generally in compliance with discharge permits issued to them by the MDEQ under the federal Clean Water Act (CWA) and the Michigan Natural Resources and Environmental Protection Act. Much treated domestic wastewater also discharges to the Watershed, and the number of these discharges is increasing as more development occurs outside of the established sewer service area.

TABLE 1-1: ANCHOR BAY WATERSHED PERMITTED DISCHARGERS

Designated Name	Permit No.	Expiration Date	Facility Type	Permittee Name
Millstone Pond MHP	MI0055816	10/01/2004	Non-Industrial Sanitary Wastewater	John Anton Builders
New Haven Foundry	MI0038032	10/01/2004	Standard (All others)	New Haven Foundry, Incorporated
Richmond WWTP	MI0023906	10/01/2004	Non-Industrial Sanitary Wastewater	City of Richmond
Americana Estates of Casco MHP	MI0027073	10/01/2004	Non-Industrial Sanitary Wastewater	Americana Estates of Casco, LLC
Chesterfield Twp WWSL	MIG960033	04/01/2005	Non-Industrial Sanitary Wastewater	Chesterfield Township
Algonac WFP	MIG640228	04/01/2005	Standard (All others)	City of Algonac
Colony Clinic	MIG081041	04/01/2005	Standard (All others)	Dr. Leonard Kasperowicz, Colony Clinic
Macomb Co Girl Scouts	MIG760006	04/01/2005	Standard (All others)	Macomb County Girl Scouts
Old Club WWTP	MIG570210	04/01/2005	Non-Industrial Sanitary Wastewater	Old Club
Selfridge ANGB	MI0055328	10/01/2005	Standard (All others)	United States Department of Defense
New Baltimore WWTP	MI0023680	10/01/2008	Non-Industrial Sanitary Wastewater	City of New Baltimore
St Clair County-Algonac WWTP	MI0020389	10/01/2008	Non-Industrial Sanitary Wastewater	St. Clair County
Hawthorn Hollow GS Camp	MIG580383	04/01/2009	Non-Industrial Sanitary Wastewater	Girl Scouts of Macomb County-Otsikita Council Inc.
Anchor Bay Schools-Casco	MIG580328	04/01/2009	Non-Industrial Sanitary Wastewater	Anchor Bay Schools
Sunrise Convenience-Emmett	MIG580370	04/01/2009	Standard (All others)	Sunrise Convenience Stores, Inc.
MDOT I-94 WB/SB Rest Area	MIG580027	04/01/2009	Non-Industrial Sanitary Wastewater	Michigan Department of Transportation
MDOT I-94 EB/NB Rest Area	MIG580026	04/01/2009	Non-Industrial Sanitary Wastewater	Michigan Department of Transportation
US Army Tank Command - R&D	MI0055948	10/01/2009	Standard (All others)	United States Army Tank Command

In addition to the discharges listed in Table 1-1, many industrial and municipal discharges within the St. Clair River Watershed have the potential to make a significant impact on the Anchor Bay area. These discharges are discussed in more detail in the St. Clair River Remedial Action Plan.

1.12 STORM WATER RUNOFF

Like all urbanizing areas, pressure from development within the Watershed has resulted in increased runoff due to reduced pervious area and development of storm water drainage systems. Changing land use patterns have dramatically altered the natural drainage throughout the area, and environmental degradation continues to result from an increased number of impervious areas, increased peak flows of storm water with resulting accelerated erosion, and decreased natural drainage and infiltration capacity.

Although storm water runoff is a natural result of the hydrologic cycle, it does carry excessive pollutants of various types, including suspended solids, oils and greases, chemicals, nutrients, and bacteria. Little site-specific monitoring data exists regarding the quality and quantity of storm water being discharged to the Watershed.

However, data that is available shows that runoff contributes elevated levels of nutrients and bacteria directly to the bay. In addition, based on data available from similar rural and urban areas, it can be concluded that these discharges are, in fact, a significant source of local contamination within the Watershed.

Many contaminants in storm water runoff are a result of day-to-day activities by Watershed residents and visitors. A major source of nutrients in storm water runoff is from over-fertilization of residential lawns. Yard waste deposited in streams and drains by riparian property owners can elevate nutrients in the streams, cause aesthetic problems, and clog small tributary streams. Littering or improper waste disposal results in solids and floating materials that degrade the aesthetics and interfere with the flow in the bay and tributary streams. Careless disregard for domestic animal waste results in elevated bacteria contamination. Accumulated small overflows of petroleum products result in oil sheens on the bay and streams that cause aesthetic problems and interfere with oxygen transfer into the tributaries.

Storm water runoff has traditionally been considered as a nonpoint source (NPS) discharge to a watershed. However, because most runoff, particularly in urban areas, is diverted through a series of curbs, gutters, ditches, and pipes, most storm water discharges are now regulated as point sources. This change in philosophy has resulted in a storm water control program, known as the Phase I and Phase II National Pollutant Discharge Elimination System (NPDES) Storm Water permit program. The major impact of this program in the Watershed is under the NPDES Phase II program, which requires urbanized areas with a population greater than 10,000 people to develop a control program for their storm water discharges. These programs require implementation of Best Management Practices (BMPs) that will reduce the quantity and improve the quality of storm water discharged to watershed tributaries and directly to the bay. Municipalities within the Watershed required to obtain an NPDES Phase II permit are listed in Table 1-2.

TABLE 1-2: MUNICIPALITIES REQUIRED TO OBTAIN NPDES PERMITS

Municipal NPDES Permitees	Permit Number	County
Macomb County	MIG610052	Macomb
Chesterfield Township	MIG610310	Macomb
Clinton Township	MIG610299	Macomb
Harrison Township	MIG610313	Macomb
Lenox Township	MIG610301	Macomb
Macomb Township	MIG610312	Macomb
City of New Baltimore	MIG610303	Macomb
City of New Haven	MIG610302	Macomb
St Clair County	MIG610055	St. Clair
Casco Township	MIG610259	St. Clair
China Township	N/A	St. Clair
City of Algonac	MIG610255	St. Clair
Clay Township	MIG610254	St. Clair
Cottrellville Township	MIG610258	St. Clair
Ira Township	MIG610253	St. Clair

This program was adopted in March 2003, by the federal and state government in recognition of the facts that 1) storm water runoff is a significant contributor of pollution within watersheds, and 2) the traditional approach of controlling point source discharges from industrial facilities and municipal treatment plants and sewer systems would not accomplish the “fishable, swimmable, drinkable” goals established under the CWA. To be successful, the WMP must establish a similar approach that looks at all sources within the Watershed and develops goals, objectives, and actions that will mitigate any impacts from all sources. Otherwise, industrial and municipal discharges could be held to exceedingly stringent standards, while larger, less defined sources, such as storm water runoff, would go uncontrolled. This double standard could prevent the Watershed from ever accomplishing needed corrections.

1.13 WATERSHED INVENTORY METHODOLOGY

A Watershed inventory was conducted to further define the sources and causes of impairments to water quality. The following activities and sources of information were used to identify the NPS sites in the Watershed:

- The inventory contained in the original WMP, Appendix B - Location of Examples of Sources and Causes, now Appendix 1A of this report, describes sites of NPS pollution. These sites, listed below, were plotted as accurately as possible on a watershed map and then entered into a spreadsheet. Sites requiring a field check were visited in December 2004, to verify the sources and causes of the NPS pollution. Measurements were also taken to calculate the loadings and reductions at that site.

    - Shoreline habitat replaced (or being replaced) with seawalls
    - Tributary streams being replaced with enclosed piping
    - Residential building encroachment upon watercourses

- Lack of soil erosion control on farms and development sites
- Obstructions (human-caused and development-worsened)
- Stockpiling foreign materials near watercourses
- Dumping of refuse near watercourses
- Lack of adequate septic systems
- Poorly designed stream crossing structures
- Destruction of wetland areas
- Road salt damage culverts
- Lack of enforcement of environmental laws
- Direct runoff from dense residential developments, parking lots, and roadways
- Leaking valves and embankments at water treatment facilities
- Unlimited livestock access to streams
- The loss of floodplain function when natural watercourses are altered as drains
- Children playing in watercourses
- General lack of education and values that promote watershed protection

- Digital ortho quarter quadrangle photographs were used to note obvious areas of erosion, significant impacts from development, and other sources of pollutants not identified in the WMP. These areas were also entered into the spreadsheet, plotted on the map, and field checked in December 2004, to verify the information and take measurements.

- In 2002 and 2003, MDEQ conducted road crossing surveys to evaluate the condition of road crossings within the Watershed. The surveys included a physical assessment on 58 major road crossings. The MDEQ Stream Crossing Inventory provided information about the physical and habitat conditions, erosion conditions, stream shape, stream appearance, and stream sediment composition, as well as surrounding land use and cover, on both the upstream and downstream sides of road crossings. The overall site conditions given to the crossing that were ranked showed that 8% were in good condition, 59% were in fair condition, and 33% were in poor condition. The information was reviewed and only the pollutant sources noted as high in the survey sheets were entered into the spreadsheet and mapped. Additional stream crossing inventory sheets were completed in December 2004, for flagged sites. The sites investigated were entered into the spreadsheet and plotted on the Watershed map.

- The St. Clair County Drain Commissioner's drain inventory study was reviewed. More than 60 erosion sites were reviewed and problem sites were mapped. Information from the field notes was entered into the spreadsheet and the photographs for selected sites were linked to the Geographic Information System (GIS). Photographs are included in a document available for review. The St. Clair County Drain Office (SCCDO) physical inventory of the St. Clair County portion of the Watershed highlighted some key concerns, including: seawalls replacing shorelines, enclosed piping on tributary streams, development along the watercourse, soil erosion, the dumping of refuse in or near the watercourse, wetland destruction, inadequate septic systems, and lack of public education. Information from the study is presented in Appendix 1A.

- Stream survey photographs, taken during the week of November 8, 2004, to November 10, 2004, by the Fishbeck, Thompson, Carr & Huber, Inc. field crew, collecting information for the hydrologic analysis, were reviewed for possible sites of NPS pollution.

- Photographs taken during a reconnaissance of the Watershed, conducted on September 10, 2004, were reviewed for possible sites of NPS pollution. These sites were entered into the spreadsheet and mapped.

- The field crews collecting information for the hydrologic study took notes and photographs of various sites to determine if they would be accepted or rejected for the hydrologic study. The photographs of the sites were reviewed to determine if any NPS pollution was evident.

A data sheet was completed at each site visited, as a result of the above investigations. Basic information was recorded about the size of the stream, surrounding land use, presence of stream buffers, and weather conditions. Twelve categories were described on the sheets: debris and trash, stream crossing, rill or gully erosion, livestock access, upland sources, tile outlet, streambank erosion, construction sites, urban/residential, marinas, row crop runoff, and other. Within each category, characteristics were described to group and rank the sites. Sample inventory forms are included in Appendix 1B.

The information from the data sheets was compiled into a spreadsheet identifying each NPS site with estimates of measurements to use to calculate pollutant loadings from those sites. The sites requiring a follow-up field visit to collect more accurate measurements were flagged. The data was verified and checked for inconsistencies, then converted to a point file into ArcMap GIS. Figure 1-6 displays the sites that were identified as contributing NPS pollutions as points on the map. The photographs of each site are linked to the points. The data was also sorted by category and ranked according to severity as recorded on the data sheets. The spreadsheet is included in Appendix 1C.

1.14 WATERSHED INVENTORY FINDINGS AND CRITICAL AREAS

The NPS sites were ranked for severity using the characteristics and measurements taken at each site. The lack of riparian buffers was noted most frequently, with a total of 35 sites identified. Streambank erosion was noted at 33 sites. Stream crossings were contributing pollutants at 30 sites. General urban runoff was observed at 29 sites. Other NPS sites and number of observation are listed in Table 1-3.

TABLE 1-3: SITES OF POLLUTANT SOURCES

LACK OF BUFFER (12)	35
BANK EROSION (7)	33
STREAM CROSSING (2)	30
RUNOFF (13)	29
NUTRIENT SOURCES (14)	18
RILL/GULLY/DITCH EROSION (3)	16
OTHER (15)	16
DEBRIS/TRASH (1)	14
CONSTRUCTION (8)	10
AGRICULTURAL SOURCES (5)	9
URBAN/RESIDENTIAL (9)	8
LIVESTOCK ACCESS (4)	5
TILE OUTLETS (6)	4
ROW CROP RUNOFF (11)	3
MARINA (10)	1

1.1.4.1 BACTERIA MONITORING PROGRAMS AND STUDIES

The Macomb County Health Department (MCHD) was one of the first government agencies in Michigan to perform regular surface water monitoring of beaches to protect public health. The program was established in 1948. In the late 1980s, the monitoring program was expanded to include watershed-monitoring and a Lake St. Clair assessment program. Since then, the Macomb County Public Works Office (MCPWO), the St. Clair County Health Department (SCCHD), and the SCCDO have established water quality monitoring programs. Over time, these programs have become better coordinated and expanded. The data collected in these programs form the baseline for this Watershed management effort.

MACOMB COUNTY

From 1948 through today, the MCHD has continued to augment their on-going monitoring efforts to include more detailed monitoring in the Watershed. This monitoring program sampled for standard water quality parameters under wet and dry weather conditions. A limited number of sites with elevated bacteria levels were also identified. The results of the monitoring are published in a yearly *Lake St. Clair Water Quality Assessment*.

Each year, the MCHD samples Lake St. Clair's nearshore and offshore waters during three periods, spring, summer, and fall. In 1998, they also sampled inshore waters. Fourteen parameters were sampled at these locations, although not all parameters were sampled all three years.

- Nearshore testing was conducted near outfalls entering the lake, including storm drains and river mouths.
- Offshore samples were taken approximately one-quarter mile from shore.
- Inshore sampling, in wet and dry weather, was conducted upstream of nearshore sites, generally one-quarter mile upstream from waterway discharge points.

The MCHD currently performs surface water sampling at 11 locations in the Watershed. One grab sample is collected at each location on a weekly basis. Sampling sites have been added as illicit discharges are suspected and as more resources become available (Table 1-4). The Salt River and Crapau Creek sampling locations have routinely exceeded the total body contact standards for *E. coli* throughout the monitoring period. Table 1-5 shows the results of sample analysis at these locations from 1995 through 2002.

TABLE 1-4: MACOMB COUNTY HEALTH DEPARTMENT SURFACE WATER SAMPLING SITES

Began Sampling	Sites Sampled
1995	Site 46 - Crapau Creek at Main Street
	Site 45 - Salt River at Lake St. Clair
	Site 47 - Salt River at Washington Road
1998	Site 37 - Salt River at 29 Mile Road and Gratiot
1999	Site 46.3 - Crapau Creek at County Line Road south of 25 Mile Road
	Site 46.7 - Crapau Creek at Ashley Street
2000	Site 46.9 - Crapau Creek upstream of Site 46
	Site 46.2 - Crapau Creek at County Line Road south of I-94
2001	Marsac Drain at Lake St. Clair

TABLE 1-5: MACOMB COUNTY HEALTH DEPARTMENT *E. COLI* ANALYSIS (MPN/100 ML)

	Site 37 Salt River at 29 Mile Road			Site 39 Marsac Drain at 29 Ruedisale Park		
Year	Yearly High	Yearly Low	Geo. Mean	Yearly High	Yearly Low	Geo. Mean
1995	*	*	*	*	*	*
1996	*	*	*	*	*	*
1997	*	*	*	*	*	*
1998	9,000	100	494	*	*	*
1999	12,033	47	500	*	*	*
2000	19,863	31	575	*	*	*
2001	4,884	10	242	9,804	1	60
2002	32,820	10	289	43,520	1	59

	Site 45 Salt River at Jefferson Avenue			Site 46 Crapau Creek at Main Street		
Year	Yearly High	Yearly Low	Geo. Mean	Yearly High	Yearly Low	Geo. Mean
1995	1,800	1	65	4,000	20	260
1996	11,500	10	135	6,000	50	338
1997	5,794	1	75	4,800	20	198
1998	500	20	93	37,000	20	398
1999	9,208	1	32	24,192	5	309
2000	5,794	1	75	12,997	20	470
2001	3,076	1	49	6,240	20	269
2002	3,076	1	44	24,192	1	191

Note: *Not Sampled

	Site 46.2 County Line Ditch at Hobarth			Site 46.3 Crapau Creek at County Line Road		
Year	Yearly High	Yearly Low	Geo. Mean	Yearly High	Yearly Low	Geo. Mean
1995	*	*	*	*	*	*
1996	*	*	*	*	*	*
1997	*	*	*	*	*	*
1998	*	*	*	*	*	*
1999	*	*	*	7,701	4	174
2000	17,329	134	1,013	14,136	10	364
2001	7,701	10	248	5,172	10	119
2002	48,840	1	238	8,164	1	146
	Site 46.6 Vanderbenne Drain at Fox Pointe			Site 46.7 Crapau Creek at Ashley		
Year	Yearly High	Yearly Low	Geo. Mean	Yearly High	Yearly Low	Geo. Mean
1995	*	*	*	*	*	*
1996	*	*	*	*	*	*
1997	*	*	*	*	*	*
1998	*	*	*	*	*	*
1999	*	*	*	9,208	22	835
2000	24,192	30	726	19,863	10	709
2001	14,136	1	229	19,863	10	321
2002	17,329	1	202	24,192	10	317
	Site 46.9 Crapau Creek at Green Street			Site 47 Salt River at Washington Street		
Year	Yearly High	Yearly Low	Geo. Mean	Yearly High	Yearly Low	Geo. Mean
1995	*	*	*	8,000	10	469
1996	*	*	*	13,600	10	811
1997	*	*	*	2,700	20	328
1998	*	*	*	6,600	100	634
1999	*	*	*	15,531	100	598
2000	12,033	1	250	24,192	10	387
2001	3,873	10	209	6,131	10	236
2002	19,863	1	113	10,462	20	264

Note: *Not Sampled

Table 1-6 shows the sediment *E. coli* analysis from samples that were collected to determine if there was a correlation between sediment and water bacterial levels. These samples indicate no apparent correlation between the two media.

TABLE 1-6: SEDIMENT *E. COLI* READINGS (CFU/G)

Site	05/19/98	07/28/98	09/22/98	05/27/99	07/15/99	09/09/99	05/11/00	07/06/00	08/31/00
Irwin Drain (N24)	1400	7200	400	3	0	2	2	0	5
Salt River (N28)	5600	6800	1100	11	0	3	0	24	260
Crapau Creek (N29)	5100	1200	800	*	*	*	*	*	*
Salt River (O3)	*	*	*	*	*	*	*	*	*
Irwin Drain (O4)	*	*	*	*	*	*	*	*	*

Note: *Not Sampled

MCPWO and MCHD received two Clean Michigan Initiative (CMI) grants in 2001 to conduct an Illicit Discharge Elimination Program (IDEP) on county storm drains and waters of the state in the Lake St. Clair and Anchor Bay Watersheds. As of December 2004, the MCPWO completed its inventory of all county drain outfalls within the Watershed. Follow up continues and will continue on all county drains with elevated *E.coli* counts until the levels meet MDEQ water quality standards (WQS). As of June 2005, a survey of the county drain outfalls within the Watershed was completed and an inventory of outfalls entering waters of the state and open county drains is approximately 90% complete. The goal of this program is to locate sources of pollution entering county drains, waters of the state and Lake St. Clair. This is accomplished through field crew surveys of inland watercourses, road ditches, county storm drains, and along the shoreline of Anchor Bay. These crews look for signs of failing onsite sewage disposal systems (OSDS), illegal dumping, and pollutants from municipal storm sewers. The Macomb County Road Commission is also sampling for *E.coli* and developing an inventory of all their outfalls within the county. In places where a source of *E. coli* contamination appears to be entering a drain or waters of the state, the MCPWO and MCHD have initiated a more extensive investigation that includes additional sampling and dye testing. They also work with local municipalities to locate and eliminate pollution sources.

ST. CLAIR COUNTY

The SCCHD collected water quality samples for *E. coli* analysis at several locations within the Watershed in 2000 and 2001. Although the resultant data shows no exceedances of the Michigan WQS for *E. coli* for partial body contact, the standards for total body contact recreation were exceeded in the Harsens Island

Main Drain at the North Channel, the Marine City Dredge Cut, and the waterway at Golf Course Lane and Cottage Lane on Harsens Island.

The SCCDO and SCCHD received two CMI grants in 2002 to conduct an IDEP on county drains, natural waterways, and road drains in the Anchor Bay and Pine River Watersheds. The Watershed was surveyed and 117 failing septic systems were found. SCCHD IDEP staff noted that, although there were few problems found on Harsens Island, a weekend survey might be needed to assess discharges from seasonal homes. Most septic system failures were found in Casco and Cottrellville Townships, and the least number were found in Ira Township, which contains sewered areas. The majority of all violations were found entering road drains and ditches. As of June 2005, 95% of these systems have been repaired or rebuilt.

BACTERIA LOADING

E. coli is present in the feces of warm blooded animals, and the detection of *E. coli* in a waterbody often indicates that other dangerous bacteria are present. WQS for *E. coli* are 130 *E. coli* per 100 ml, as a 30-day geometric mean, and 300 *E. coli* per 100 ml, as a daily geometric mean. Leakage from lagoon systems and package treatment plants in Casco Township could also be adding *E. coli* to the system. Additional sources include agricultural operations that allow livestock unlimited access to the stream and feedlot runoff. Non-human sources have been identified through DNA testing to be contributing *E. coli* to the Salt River and could be a source in other urban and lakeshore areas. Loadings of *E. coli* are difficult to determine without extensive sampling and investigation. Therefore, loadings have only been determined for Crapau Creek and the Salt River, both of which are on the State's 303 nonattainment list for not meeting WQS. The total maximum daily load (TMDL) reports for Crapau Creek and Salt River are included in Appendix 1D.

CRAPAU CREEK

The MDEQ sampling for the TMDL study on Crapau Creek had a range of 66 to 2,417 *E. coli* per 100 ml, as a 30-day geometric mean. For Crapau Creek, the Waste Load Allocation (WLA) for the two permitted dischargers, the City of New Baltimore Wastewater Treatment Plant (WWTP) and Millstone Pond Mobile Home Park WWTP, is 200 fecal coliform per 100 ml, as a 30-day geometric mean. Since *E. coli* is a subset of fecal coliform, the 130 *E. coli* per 100 ml WQS will be met if WLAs are met by the permittees. The Load Allocations (LAs) for NPS discharges are distributed according to the land area of each jurisdiction within the Watershed, since the TMDL is concentration-based and assumes that all land, regardless of use, will be required to meeting the WQS. This loading is limited to 130 *E. coli* per 100 ml, and the land area gives an indication of the amount of effort that will be required by each community to meet that loading limit.

The government entities and percentage of land within Crapau Creek are the City of New Baltimore (39%), Ira Township (22%), Casco Township (15%), Chesterfield Township (13%), and Lenox Township (11%). Urban storm water runoff and illicit discharges are likely the dominant sources of *E. coli* to Crapau Creek (Thelen, 2001).

SALT RIVER

The MDEQ sampling for the TMDL study on the Salt River had a 30-day geometric mean range of 23 *E. coli* per 100 ml in September at 26 Mile Road to 698 *E. coli* per 100 ml in July at 23 Mile Road. The highest observed concentrations in the Salt River were located at the 23 Mile Road station. For the Salt River, the WLA for the two permitted dischargers, the City of Richmond WWTP and Northhampton Mobile Home Park WWTP (when constructed), is 200 fecal coliform per 100 ml, as a 30-day geometric mean. The LAs for NPS discharges are distributed according to the land area of each jurisdiction within the Watershed. This loading is limited to 130 *E. coli* per 100 ml, and the land area gives an indication of the amount of effort that will be required by each community to meet that loading limit. The government entities and percentage of land within the Salt River are Lenox Township (48%), Chesterfield Township (32%), Village of New Haven (9%), Casco Township (4%), the City of Richmond (3%), Richmond Township (2%), and the City of New Baltimore (2%). Agricultural runoff, failing septic systems, and pet and/or wildlife wastes are likely the dominant sources of *E. coli* to the Salt River (Alexander, 2005).

POTENTIAL SOURCES OF BACTERIA

OSDS

The Watershed has sanitary sewers in the developed western portion, but is heavily dependent on septic systems, also known as OSDS, in the more open, agricultural areas in its eastern portion. If properly sited, constructed, used, and maintained, these systems will provide reliable service over many years. However, MCHD and SCCHD personnel have indicated that soils in much of the Watershed have generally very limited permeability for sewage disposal. Much of the area has a high water table and, as a result, onsite systems generally need to be specially designed and constructed to compensate for the soil types. The relatively impervious soils result in higher costs, higher failure rates, and shorter system life than in areas with highly pervious sands and gravels.

Failing onsite septic systems result in illicit discharges or a discharge of semi-treated or untreated sewage to a watercourse. These discharges often take the form of sewage seeping into a nearby improved drainage course or through “cheater pipes” that alleviate sewage backups caused by a failed drain field.

To put the issue in perspective, the average residence uses 100 to 300 gallons of water daily, meaning that each failing system could contribute over 35,000 gallons of untreated wastewater to its watershed annually. This, along with system failure rates higher than 25% in some areas, underscores the importance of local programs to assure proper installation and use of onsite systems.

The SCCDO conducted a limited physical inventory in 2003 of all or parts of 24 county drains within the St. Clair County portion of the Watershed to determine sources of pollution and establish concerns. Detailed findings of this inventory can be found in Appendix 1A. This physical inventory substantiates that septic system failures were a considerable source of bacteria for county drains. A current survey would need to occur in order to establish if failing septic systems are still a large problem after the repair and rebuilding of the 117 septic failures reported by the SCCDO and SCCHD. Language regarding the need for maintaining septic system inspections in St. Clair County has been developed now that the initial survey is complete.

On August 1, 2003, Macomb County's regulations governing OSDS became effective. In the first year of the program, OSDS failure rates were equivalent to the rates predicted and similar to those reported in other jurisdictions operating an equivalent program. OSDS failures ranged from small minor repairs (i.e. replacing the broken or missing tank outlet device), to complete replacement of the septic system. The information obtained from the results of the first year of operation revealed much insight into the operation and maintenance of OSDSs in Macomb County. Evidence indicates that many sites lack routine maintenance (i.e. scheduled tank pumping), on the owner's behalf. Future analyses planned will include detailed breakdowns as to the type and location of failure. Macomb County's regulations are developing into a program that enhances the quality of life for all residents of Macomb County through increased system maintenance and owner education.

SEWERED AREA SOURCES

Three potential sources of contamination within sewered areas are illicit connections, sanitary sewer overflows (SSOs), and combined sewer overflows (CSOs).

An illicit connection is a sewer pipe connected to a storm drain rather than to a sanitary sewer. Typically, these are connected inadvertently at the time of construction and are difficult to isolate because they discharge intermittently. If left uncorrected, however, these intermittent discharges contribute a significant pollutant load.

SSOs occur when sanitary sewers cannot carry all water that falls during a rain event. Rather than cause sewage backups into area basements, a pump or bypass structure diverts flow to a local tributary stream. Technically, sewer breaks or equipment malfunctions that result in overflows from sanitary sewers to streams/drains are also considered to be SSOs. While there are no known SSOs within the Watershed, the age of some of the development within the Anchor Bay drainage area suggests that undetected SSOs could exist.

Like SSOs, CSOs are caused by rain events. CSO discharges to the Watershed come from the Clinton River, which is not part of the designated watershed. However, when certain wind and current conditions are present, contaminants from Clinton River sewer systems, such as bacteria, organic chemicals, and metals, can add sediment accumulations and loadings that contribute to decreased water quality.

LAGOON SYSTEMS AND PACKAGE TREATMENT PLANTS

Proliferation of small lagoon systems and package wastewater treatment facilities discharging to the bay and its tributaries is a concern for many county and local government officials. Increased use of these facilities can result in degradation of local and watershed-wide water quality when facility operation and maintenance is not closely monitored and regulated. Likewise, negative cumulative effects can occur when monitored and regulated discharges from various facilities are not well coordinated.

In the SCCDO physical inventory, “leaking valves and embankments at water treatment facilities” is noted as a problem (Appendix 1A). The impacts of these facilities on an individual and collective basis can include elevated *E. coli* bacteria densities and nutrient concentrations as well as aesthetic and water quality degradation from excessive algae and green discoloration in facility discharges. Although these impacts are not well documented, proliferation of separate sewage treatment facilities that utilize lagoons or low-volume secondary treatment plants (package plants) is becoming an increasing concern to public officials, regulators, and the general public.

AGRICULTURAL RUNOFF

Although the amount of land being used for livestock and dairy operations in the Watershed has decreased over time, a significant portion of the Watershed is still used for cropland, livestock and dairy operations, and equestrian activities. Stream contamination can occur from several sources related to agriculture. Direct impacts from cattle crossing streams and horse-related activities could include elevated bacteria in the streams from manure contaminated runoff.

WASTE PRODUCTS FROM PETS, BIRDS, AND WILDLIFE

All warm-blooded animals have *E. coli* bacteria in their digestive systems. Pets, birds, and wildlife in urban areas deposit waste products directly into surface water and storm sewers. This contaminates discharges to the waterways, resulting in elevated bacteria levels in the rivers and the bay.

CRITICAL AREA FOR BACTERIA

Crapau Creek and Salt River have been on the state's impaired waters list (303(d) list) since 1998 for long-term violation of *E. coli* standards based on water quality data collected by the MCHD and the MDEQ. Therefore, those two subwatersheds are critical areas for bacterial contamination.

1.1.4.2 SOIL EROSION AND SEDIMENTATION LOADINGS

Erosion is the process of displacing soil particles through wind and water action. This process is natural, but can be accelerated by human activities of construction and agricultural practices. Sedimentation is the process where the dislodged soil particles are deposited elsewhere on land, in streams, rivers, lakes, or wetlands. The predominantly clay soils found within the Watershed create unique problems with sedimentation control. These clay soils tend to remain in suspension and are extremely difficult to remove from the water column using conventional sedimentation techniques. The result is highly turbid runoff in tributary streams and storm water systems that tend to remain sediment-laden for an extended period of time after rainfall events. The MDEQ has stated that tributary streams within the Watershed regularly flow brown for days after significant rainfall events from increased sediment loadings.

Erosion and sedimentation impacts include deposition, turbidity, increased pollutant loading, and destruction of wildlife habitat:

- *Deposition* affects stream morphology (shape), causing the stream to widen and become shallower, making it prone to temperature changes.

- *Turbidity* is cloudiness caused by sediment in water. Highly turbid water results in degradation of habitat and impaired aesthetics within waterways. Sediment particles affect fish, aquatic plants, and animals by causing starvation or suffocation. In fish, these sediment particles adhere to gill structures and lodge in feeding or breathing structures. Turbid water may also inhibit hunting, which disrupts the natural relationship of predator and prey.

- *Pollutant Loading* is also increased by erosion and sedimentation. Pollutants, such as heavy metals, fertilizers, and pesticides, adhere to soil and are transported to the receiving water through erosion and sedimentation.

- *Wildlife Habitat* can be destroyed as sediments fill in voids created by woody debris, rocks and gravel that are used as cover by young fish and other aquatic species. Sedimentation also destroys fish and spawning areas.

The method used to provide a gross estimate of sediment loadings from the identified NPS sites in agricultural areas is based on the MDEQ's "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual," June 1999. The St. Clair and Macomb Counties' Natural Resources Conservation Service district office was contacted to get information about cropping rotations, tillage practices, slope length factors, and general soils information to use the Michigan State University's "RUSLE - Online Soil Erosion Assessment Tool" for sediment loadings from cropland runoff in the Watershed. The estimated sediment loading from agricultural areas is 13,637 tons per year. The methodologies and assumptions to estimate these loadings are included in Appendix 1E.

Loadings from urban areas were estimated using the methodology and efficiency values developed by the Illinois Environmental Protection Agency (EPA). These worksheets used land use data and associated impervious surface coefficients to determine pollutant loadings contained in urban runoff. The estimated loading for sediment from urban areas is 7,723 tons per year. The worksheets and land use data used to calculate these estimates are included in Appendix 1F.

POTENTIAL SOURCES OF SOIL EROSION AND SEDIMENTATION

CONSTRUCTION

Construction activity usually results in compacted soils due to heavy equipment and removal of natural features, such as vegetated areas, that prevent soil erosion. When vegetation is removed, the exposed soils are more susceptible to movement by water runoff and wind. Clay based soils dominate the Macomb County portion of the Watershed and much of St. Clair County. Communications from the Technical and Steering Committees for the WMP, as well as noted in the physical inventory conducted by the SCCDO, indicate that soil erosion and sedimentation control (SESC) measures on construction sites are not well maintained or are non-existent. The SCCDO physical inventory substantiates the lack of SESC measures, lack of maintenance of these measures on construction sites, and lack of enforcement of existing ordinances and programs along county drains in the St. Clair County portion of the Watershed.

FLOWS

Increased impervious area due to land use changes can result in excessive flows in receiving streams. This excessive flow can be exhibited by higher peak flows, longer peak flow periods, or both. The SCCDO physical inventory indicates evidence of high flows causing streambank erosion. The results of these excess flows are increased streambank erosion, increased bottom scour, sediment re-suspension, habitat destruction, and decreased diversity and number of fish and aquatic organisms.

AGRICULTURAL RUNOFF

Farming to the edge of streambanks can result in streambank erosion during runoff events and increased sediment loading from farm fields. Direct impacts from agricultural areas include streambank erosion where the banks have been leveled and stripped of grass from movement of the cattle and horses, and destruction of stream bottom habitat and downstream sedimentation damage to the habitat from cattle walking in the stream. The SCCDO physical inventory and recent field work substantiates the lack of consistent agricultural practices across St. Clair County and found the existence of the following activities that contribute to SESC:

- Plowing to the edge of a county drain
- Field drain ditches that cause erosion at their outlets
- Livestock traffic and tractor traffic across watercourses that erode banks and damage tree roots that would, otherwise, help stabilize soil

ROAD CROSSINGS

As evidenced by the MDEQ road crossing survey, road crossings are a source of SESC problems. Poorly designed road crossing structures, evidence of limited maintenance, and resident-built waterway crossings are also noted in the SCCDO physical inventory of county drains.

CRITICAL AREA FOR EROSION AND SEDIMENTATION

Sediments typically come from disturbed land on construction sites, agricultural areas, and eroding streambanks caused by excessive water flows. The sources of sediment in the Watershed were found to be originating from construction activities and a lack of SESC measures enforced in the Watershed. Areas that are planned to be developed, either low- or high-intensity, have been identified through a build out analysis of the Watershed.

SEMCOG

SEMCOG prepares a yearly report that documents new residential construction occurring in each county and community in Southeast Michigan. The report states that Macomb County was ranked third highest, out of the seven communities ranked, in new residential permits issued, with 5,401 permitted units. St. Clair County was ranked sixth, with 964 new residential permits issued. Macomb County was also ranked the top community for total units authorized for the eighth consecutive year (SEMCOG, 2005).

Macomb Township, in Macomb County, was the top community for total units authorized for the eighth consecutive year. Table 1-7 lists the communities in the Watershed, with their number of total units and the future percent imperviousness of those communities, projected through the build out analysis (FTC&H, 2005).

TABLE 1-7: AUTHORIZED NEW HOUSING UNITS BASED ON RESIDENTIAL PERMITS ISSUED, 2004

Macomb County	Units	Future % Impervious*	St. Clair County	Units	Future % Impervious*
Macomb Township	1,086	>25%	Clay Township	54	>25%
Clinton Township	776	>25%	Casco Township	28	<10%
Chesterfield Township	663	>25%	China Township	28	<10%
New Baltimore	142	>25%	Ira Township	26	10-25%
New Haven	130	10-25%	Cottrellville Township	19	10-25%
Harrison Township	110	10-25%	Algonac	12	>25%
Richmond	48	>25%			
Richmond Township	32	10-25%			
Lenox Township	11	10-25%			

*Based on results of build out analysis (FTC&H, 2005).

Critical areas for erosion and sedimentation control are therefore those areas with the most development occurring and highest percentage imperviousness: Macomb, Clinton, Chesterfield, New Baltimore, and Clay Townships. These communities have been determined to be part of the critical areas of the Watershed for erosion and sedimentation since runoff from construction sites is contributing to the sedimentation in the waterways. Streambank erosion, caused by flashy flows from an increase in impervious surfaces, has also been identified. Agricultural runoff is allowed to enter the stream due to the absence of stream buffers and soil erosion control structures in many areas of the Watershed.

Additional critical areas for erosion and sedimentation would be agricultural fields adjacent to waterways, including the additional acres of the contributing area. Over 104 miles of stream intersect agricultural areas, all of which could benefit from filter strips and other erosion control measures, such as conservation tillage and water and sediment control structures, which reduce erosion. Several road crossings were found to have poor designs, in terms of erosion control, and the many gravel roads add to the sedimentation problem. Specific sites are identified on the Figure 1-6.

1.1.4.3 NUTRIENT MONITORING PROGRAMS AND STUDIES

Previous water quality data collected by the MCHD from 1998 to 2000 show that water at the sampling locations exceeded levels of concern values or had higher than average readings throughout the three-year period. A majority of the locations measured total phosphorus above the standard for water quality of 0.05 mg/l at least once. Nearly half of the locations also displayed low dissolved oxygen levels of less than 5 mg/l at least once. These levels suggest that Anchor Bay is being degraded by excessive nutrients. Continued urbanization will likely aggravate this problem.

NUTRIENT LOADINGS

The method used to provide a gross estimate of phosphorus and nitrogen loadings from the identified NPS sites in agricultural areas is based on the MDEQ's "Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual", June 1999. The St. Clair and Macomb Counties NRCS district office was contacted to get information about cropping rotations, tillage practices, slope length factors, and general soils information to use the Michigan State University's "RUSLE - Online Soil Erosion Assessment Tool" for nutrient loadings from the cropland runoff in the Watershed. The estimated phosphorus loading from agricultural areas is 30,466 pounds per year. The estimated nitrogen loading from agricultural areas is 15,233 pounds per year. The methodologies and assumptions to estimate these loadings are included in Appendix 1E.

Loadings from urban areas were estimated using the methodology and efficiency values developed by the Illinois EPA. These worksheets used land use data and associated impervious surface coefficients to determine pollutant loadings contained in urban runoff. The estimated loadings for total phosphorus from urban areas are 22,830 pounds per year. The estimated loadings for total nitrogen from urban areas are 203,906 pounds per year. The worksheets and land use data used to calculate these estimates are included in Appendix 1F.

POTENTIAL SOURCES OF NUTRIENTS

Phosphorus and nitrogen are chemicals that are commonly used in fertilizer to encourage rapid growth. These same chemicals increase nutrient levels in open waterways and promote algae growth in Anchor Bay. Although excessive aquatic plant and algae growth is generally phosphorus limited, increased levels of nitrogen and phosphorus can lead to low, dissolved oxygen thus exacerbating growth of aquatic nuisance plants. It is suspected that increased aquatic plant growth contributes to the public health problem by trapping fecal-contaminated waters in the near shore areas, which in turn causes beach closures. This hypothesis was included as part of the August 2000, revision of the Report and Recommendations of the Macomb County Blue Ribbon Commission on Lake St. Clair.

The field investigations determined that the sources of nutrients in the Watershed are originating from urban runoff, agricultural runoff, and possibly golf courses. Excessive use and application of fertilizers on lawns and cropland cause nutrients to enter the waterways. The lack of natural filtration (private ponds) leads to urban runoff. The lack of stream buffers and other agricultural BMPs also allow nutrients to enter the streams. Golf courses use fertilizers to keep conditions at their prime for golfing, but excessive use can result in runoff going into the streams.

URBAN SOURCES

Excessive use of fertilizers is the major source of nutrients from urban residential areas. Natural wetlands can remove some nutrients from storm water runoff, but development has reduced these natural filtration areas, resulting in untreated storm water runoff to tributaries and increased nutrients in the Watershed and the bay.

AGRICULTURAL SOURCES

Improperly managed agricultural runoff can contribute fertilizers, pesticides, and herbicides to nearby water and can also create excess particulates from soil erosion and general ecosystem damage. Although there has been a general decline in livestock sites for dairy, beef, swine, and poultry, a significant equine-related agricultural industry still exists within the Watershed. A significant amount of acreage is devoted to soybean, wheat, and corn production. A consistent application of agricultural BMPs, such as buffer strips, limiting cattle access to streams, and implementation of Nutrient Management Plans will reduce these impacts within the Watershed and the bay. Although limited information is available regarding agricultural runoff, public comment indicates a lack of consistent application of agricultural BMPs within the Watershed.

CRITICAL AREA FOR NUTRIENTS

Data from the *Lake St. Clair Water Quality Assessment* report shows elevated nutrient levels from inland watercourses that drain residential and agricultural areas. Since direct runoff from residential areas is likely to cause the greatest impact, critical area have been determined to be all residential areas adjacent to waterways. Mapping these areas would simply be identifying the residential land use where it intersects any waterway. These riparian areas could benefit from filter or buffer strips, creating a protected riparian corridor.

Runoff from agricultural areas is also influenced by the proximity of the waterway. Additional critical areas for nutrients would be agricultural fields adjacent to waterways, including the additional acres of the contributing area. Over 104 miles of stream intersect agricultural areas, all of which could benefit from filter strips and other agricultural control measures, such as conservation tillage and water and sediment control structures, which reduce the amount of nutrients entering the waterways. Specific sites are identified on the Figure 1-6.

1.1.4.4 FLOW RATE MONITORING AND STUDIES

Flow monitoring was conducted in 2004 to calibrate the hydrologic model. Flows at three sites were monitored:

1. Marsac Creek at Bethuy Road
2. Swan Creek at Lindsay Road
3. Salt River at 30 Mile Road

The preliminary conclusions of the monitoring were that the bankfull flows may be lower than those calculated by MDEQ, which were used for the hydrologic modeling. The monitoring revealed that a good correlation existed between measured flows and flows calculated from the field survey results. (FTC&H, 2005. Anchor Bay Watershed Technical Report)

POTENTIAL SOURCES FOR INCREASED FLOW RATES

The original WMP identified potential sources of increased flows. These sources were substantiated in the field work conducted in 2004.

LAND USE AND IMPERVIOUS SURFACES

Increased impervious areas within the Watershed, caused by changes in land use, result in higher storm water runoff that quickly reaches tributary streams, often causing flooding and streambank erosion. Left unchecked, the changes to the river flow will cause serious damage to the physical and biological integrity of the receiving stream. A limited physical inventory, conducted in 2003 by the SCCDO, highlighted that high flow rates have been a problem in many county drains.

Impacts of increased impervious areas include:

- *Water quality degradation:* pollutant types and concentrations increase substantially as oils, sediment, trace metals, nitrogen, and phosphorus are washed from urban areas into waterways
- *Increased flooding:* peak flows are increasing two to five times over predevelopment flow rates, and runoff reaching the stream up to 50% faster
- *Increased erosion:* The channel may widen and undercut streambanks that may fall into the river
- *Accelerated habitat loss:* The removal of streamside vegetation and increase of flows, change the ecology needed for a healthy habitat adjacent to rivers and streams
- *Biodiversity loss:* Fish communities may become less diverse, and sensitive fish species may be lost

- *Higher water temperature:* Waterways change characteristics due to heated pavement and wider, shallower streams

CRITICAL AREA FOR EXCESSIVE FLOW RATES

The information from the hydrologic modeling and the build out analysis resulted in a model storm water ordinance for communities in the Watershed to adopt. The model ordinance provides design standards for criteria of flood control, stream protection, water quality, spill protection, groundwater recharge, and low impact development (LID). Most areas of the Watershed would follow the "Standard" criteria, minimizing the effects of storm water for each level of criteria. Alternative design criteria would be required in areas that have unique circumstances. Coastal zones are those areas with direct discharge to the Anchor Bay and the St. Clair River, which also have specific design specifications. These criteria and design specifications are described in Table 1-8. The results of the model indicate that the use of design criteria can protect the Watershed. An overall goal of reducing runoff volume and decreasing impervious surfaces should be followed to protect the Watershed.

Table 1-8: Summary of Design Standards for Model Storm Water Ordinance

CRITERIA	STANDARD	ALTERNATE	COASTAL ZONE
Flood Control	Detention of 100-year runoff volume with a maximum allowable release rate of 0.15 cfs/acre of developed site	1. Detention required to match existing flows or downstream capacity if standard detention criteria will have a negative effect 2. No detention required if un-detained discharge to pond/wetland will have no measurable effect on water levels 3. In Crapau Creek, detention of 100-year runoff volume with a maximum allowable release rate of 0.1 cfs/acre of developed site is required	Direct discharge to Anchor Bay and St. Clair River
Stream Protection	Extended detention (24-hour) of runoff produced by a 1.5-year storm event from developed site	No detention required if un-detained discharge through a pond/wetland does not increase streambank erosion	Direct discharge to Anchor Bay and St. Clair River
Water Quality	Treat first 0.5-inch of rainfall through: 1. Permanent pool 2. Extended detention 3. Infiltration 4. Other treatment device (filter, vegetation, swirl concentrator)	Same as Standard	Same as Standard
Spill Protection	Containment or treatment required in areas that have high potential for storm water contacting polluting materials	Same as Standard	Same as Standard

Table 1-8: Summary of Design Standards for Model Storm Water Ordinance

CRITERIA	STANDARD	ALTERNATE	COASTAL ZONE
Groundwater Recharge	May require infiltration to avoid an increase in runoff volume or where it is important to sustain groundwater levels, such as for perennial streams or wetlands	Same as Standard	Not required
LID (reducing runoff volume through impervious area reduction, infiltration, interception and re-use)	Encouraged to reduce runoff volume and rate of discharge	Same as Standard	Encouraged to reduce size of water quality controls

1.1.5 OTHER POLLUTANTS AND THEIR SOURCES

AIRBORNE DEPOSITION

Airborne deposition directly to the Anchor Bay drainage area and water surface area is small, but significant, due to the small surface area of its drainage basin. However, the volume of airborne deposition can become even more significant when pollutants are considered that fall into Lake Huron and its drainage basin, then flow into the Anchor Bay. It is believed that most organochlorine pesticides found in the St. Clair River - alpha-BHC, gamma-BHC (lindane), dieldrin and heptachlor epoxide - come from upstream locations, including Lake Huron. A recent study conducted by the Detroit Water and Sewerage Department, *Atmospheric Deposition Study of PCBs, Mercury, and Cadmium*, concluded that precipitation contained mercury, cadmium, and PCBs at analytically detectable levels.

The study also showed that there was a definite “first-flush” phenomenon associated with the concentration of these materials in runoff from residential and industrial sites within the study area. That is, the first storm water runoff in a storm is more contaminated because the land surface it runs over has collected pollutants over a period of time. As the runoff continues and the land surface becomes cleaner, the quality of the runoff improves. The airshed of Anchor Bay is therefore determined to be a critical are for airborne deposition.

ACCIDENTAL SPILLS

The number and size of accidental releases of materials to the environment (commonly known as spills) have been reduced significantly over the last ten years. Historical spill events have resulted in contaminated sediment and transient water quality impacts. Spills can increase chemical contamination of the water and sediment, cause fish kills and other habitat impacts, and degrade aesthetics. Critical areas for spills are the major roadways and railway corridors that carry chemicals and other potential contaminants through the Watershed.

DEBRIS AND TRASH

Dumping trash along the banks and directly into Watershed tributaries and the bay is an activity that is, unfortunately, a result of day-to-day human activities. This activity can cause fish and wildlife mortalities, blockages, disease, and reduced public enjoyment. The 2003 SCCDC physical inventory and recent field work found that dumping of refuse in or near watercourses was a common activity and resulted in degraded water quality. A lack of Watershed stewardship results in apathy toward the protection of the water resources. Since dumping can occur anywhere, the entire Watershed is considered a crucial area for debris and trash.

INVASIVE/NON-NATIVE SPECIES

Invasive plant and aquatic species pose a threat to native fish, wildlife, and natural areas in the Watershed. Unlike other Watershed impacts that may be attributed to land use change, the introduction of invasive species results from transient activities, such as shipping and recreational boating. If allowed to flourish in natural areas and watercourses, invasive aquatic species, such as zebra mussels and sea lamprey, can out-compete native species and eliminate a food source for mature fish and wildlife. Likewise, invasive wetland plants, such as purple loosestrife and phragmites, can overtake a diverse wetland habitat. Collectively, these exotic species cause great harm to fragile and unique natural areas in Anchor Bay.

- *Phragmites* is a tall plumed perennial wetland grass that ranges in height from 3 to 13 feet. This reed-like species is commonly found along roadsides, ditches, dredged areas, and in freshwater marshes. It can form colonies hundreds of acres in size. Phragmites chokes out more beneficial vegetation, such as cattails and other native plants that provide food and habitat to native fish and wildlife. Currently, the MDEQ, in partnership with the U.S. Army Corps of Engineers, Ducks Unlimited, and other state conservation groups, are participating in a research program using beetles, herbicides, and controlled burns to eradicate or control phragmites in St. Johns Marsh and nearby Algonac State Park.

- *Purple Loosestrife* is a wetland perennial that can produce more than two million seeds annually. An invasion by purple loosestrife can overtake native plants in a wetland, resulting in eventual alteration of the wetland's structure and function. No effective method of controlling purple loosestrife has yet been discovered or implemented. However mowing or cutting, burning, herbicide application, or releasing herbivore beetles to eat the plant roots has provided limited success. The Galerucella Beetle has been credited with wiping out large stands of purple loosestrife in southern Michigan.

- *Zebra Mussels*, an invading species from Eurasia, was introduced into the Great Lakes through ballast water, which is used in ships to maintain stability in open waters and along coastal areas. The water, itself, can be contaminated with organisms that include plants, animals, bacteria, and pathogens all of which may displace native species, degrade native habitat, spread disease, and disrupt human social and economic activities that depend on water resources. The non-native zebra mussel, for example, has reduced plankton populations, clogged municipal water intakes, and impacted recreational boating in Anchor Bay.

Recently, the State of Michigan (State) took action to protect the Great Lakes from aquatic nuisance species. Senator Birkhortz, Representative Palsrok, and Governor Granholm secured passage of a package of bi-partisan bills in June 2005, requiring ocean-going vessels in Michigan's ports to treat ballast water and prevent the spread of aquatic invasive species. This legislation was passed to stop the spread of aquatic nuisance species and to protect against additional species that might be transported into the Great Lakes (and from the Great Lakes to other parts of the world) through ballast water. The critical areas determined for invasive species include these transportation and recreational waters and areas that have been identified as supporting endangered, threatened, or special concern species. Table 1-9 lists areas for protection, based on the Michigan Natural Features Inventory (MNFI). Figure 1-7 illustrates the number of MNFI occurrences in each Public Land Survey System section (Township, Range, Section). This database contains both historic and recent occurrence sightings. The count is based on a polygon representation of the occurrence. An individual occurrence may be present in more than one section. The darker shades of green indicate a greater number of occurrences. In the Watershed, the occurrences range from 0 to 41 occurrences. As shown, the eastern shoreline of the Watershed along the St. Clair River is a unique ecosystem that has been recognized as one of the 10 most sensitive habitats in the world (Appel, et. al).

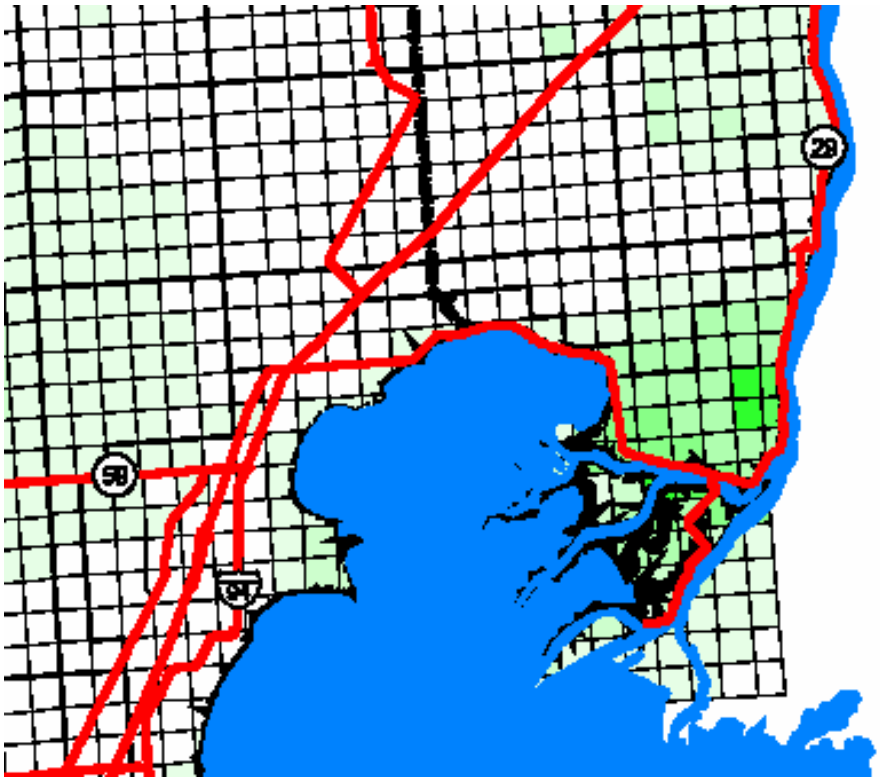

Figure 1-7: Number of Occurrences

Data sources: Michigan Natural Features Inventory database of threatened, endangered, and special concern species and high quality natural communities.

Michigan State University Extension

TABLE 1-9: WATERSHED STATUS OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES
(CURRENT AS OF 01/04/2005)

Swartout Drain			Marine City Drain			St. Clair River Drainage		
Scientific Name	**Common Name**	**State Status**	**Scientific Name**	**Common Name**	**State Status**	**Scientific Name**	**Common Name**	**State Status**
Acipenser fulvescens	Lake Sturgeon	T	Acipenser fulvescens	Lake Sturgeon	T	Acipenser fulvescens	Lake Sturgeon	T
Ammocrypta pellucida	Eastern Sand Darter	T	Agalinis gattingeri	Gattinger's Gerardia	E	Aristida longespica	Three-awned Grass	T
Aristida longespica	Three-awned Grass	T	Agalinis skinneriana	Skinner's Gerardia	E	Asclepias purpurascens	Purple Milkweed	SC
Asclepias sullivantii	Sullivant's Milkweed	T	Aristida longespica	Three-awned Grass	T	Asclepias sullivantii	Sullivant's Milkweed	T
Baptisia lactea	White or Prairie False Indigo	SC	Asclepias sullivantii	Sullivant's Milkweed	T	Baptisia lactea	White or Prairie False Indigo	SC
Carex festucacea	Fescue Sedge	SC	Baptisia lactea	White or Prairie False Indigo	SC	Carex festucacea	Fescue Sedge	SC
Cirsium hillii	Hill's Thistle	SC	Carex festucacea	Fescue Sedge	SC	Cirsium hillii	Hill's Thistle	SC
Clemmys guttata	Spotted Turtle	T	Cirsium hillii	Hill's Thistle	SC	Clemmys guttata	Spotted Turtle	T
Cypripedium candidum	White Lady-slipper	T	Clemmys guttata	Spotted Turtle	T	Elaphe vulpina gloydi	Eastern Fox Snake	T
Delta	Geographical Feature		Delta	Geographical Feature		Epioblasma triquetra	Snuffbox	E
Epioblasma triquetra	Snuffbox	E	Dendroica cerulea	Cerulean Warbler	SC	Fimbristylis puberula	Chestnut Sedge	X
Fimbristylis puberula	Chestnut Sedge	X	Elaphe vulpina gloydi	Eastern Fox Snake	T	Hiodon tergisus	Mooneye	T
Lakeplain wet prairie	Alkaline Wet Prairie, Midwest Type		Epioblasma triquetra	Snuffbox	E	Ludwigia alternifolia	Seedbox	SC
Lakeplain wet-mesic prairie	Alkaline Tallgrass Prairie, Midwest Type		Fimbristylis puberula	Chestnut Sedge	X	Noturus stigmosus	Northern Madtom	E
Papaipema beeriana	Blazing Star Borer	SC	Flexamia delongi	Leafhopper	SC	Papaipema beeriana	Blazing Star Borer	SC
Percina copelandi	Channel Darter	E	Flexamia reflexus	Leafhopper	SC	Papaipema sciata	Culvers Root Borer	SC
Platanthera ciliaris	Orange or Yellow Fringed Orchid	T	Great Blue Heron Rookery	Great Blue Heron Rookery		Percina copelandi	Channel Darter	E
Polygala cruciata	Cross-leaved Milkwort	SC	Hemicarpha micrantha	Dwarf-bulrush	SC	Platanthera ciliaris	Orange or Yellow Fringed Orchid	T

TABLE 1-9: WATERSHED STATUS OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES
(CURRENT AS OF 01/04/2005)

Swartout Drain			Marine City Drain			St. Clair River Drainage		
Scientific Name	**Common Name**	**State Status**	**Scientific Name**	**Common Name**	**State Status**	**Scientific Name**	**Common Name**	**State Status**
Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	X	Hypericum gentianoides	Gentian-leaved St. John's-wort	SC	Polygala incarnata	Pink Milkwort	X
Prosapia ignipectus	Red-legged Spittlebug	SC	Juncus brachycarpus	Short-fruited Rush	T	Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	X
Ranunculus ambigens	Spearwort	T	Lakeplain oak openings			Ranunculus ambigens	Spearwort	T
Ranunculus rhomboideus	Prairie Buttercup	T	Lakeplain wet-mesic prairie	Alkaline Tallgrass Prairie, Midwest Type		Ranunculus rhomboideus	Prairie Buttercup	T
Scleria pauciflora	Few-flowered Nut-rush	E	Ludwigia alternifolia	Seedbox	SC	Scleria pauciflora	Few-flowered Nut-rush	E
Triplasis purpurea	Sand Grass	SC	Lycopodiella subappressa	Northern Appressed Clubmoss	SC	Stizostedion canadense	Sauger	T
			Papaipema beeriana	Blazing Star Borer	SC			
			Papaipema sciata	Culvers Root Borer	SC			
			Percina copelandi	Channel Darter	E			
			Platanthera ciliaris	Orange or Yellow Fringed Orchid	T			
			Polygala cruciata	Cross-leaved Milkwort	SC			
			Polygala incarnata	Pink Milkwort	X			
			Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	X			
			Prosapia ignipectus	Red-legged Spittlebug	SC			
			Ranunculus ambigens	Spearwort	T			
			Ranunculus rhomboideus	Prairie Buttercup	T			
			Scirpus clintonii	Clinton's Bulrush	SC			
			Scleria pauciflora	Few-flowered Nut-rush	E			

TABLE 1-9: WATERSHED STATUS OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES
(CURRENT AS OF 01/04/2005)

Marine City Drain

Scientific Name	Common Name	
Scleria triglomerata	Tall Nut-rush	
Stizostedion canadense	Sauger	
Triplasis purpurea	Sand Grass	

Beaubien Creek

Scientific Name	Common Name	State Status
Acipenser fulvescens	Lake Sturgeon	T
Ammocrypta pellucida	Eastern Sand Darter	T
Aristida longespica	Three-awned Grass	T
Baptisia lactea	White or Prairie False Indigo	SC
Carex festucacea	Fescue Sedge	SC
Cirsium hillii	Hill's Thistle	SC
Clemmys guttata	Spotted Turtle	T
Delta	Geographical Feature	
Fimbristylis puberula	Chestnut Sedge	X
Platanthera ciliaris	Orange or Yellow Fringed Orchid	T
Polygala cruciata	Cross-leaved Milkwort	SC
Polygala incarnata	Pink Milkwort	X
Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	X
Ranunculus ambigens	Spearwort	T

Palms Road Drain

Scientific Name	State Status	State Status
Acipenser fulvescens	SC	T
Ammocrypta pellucida	T	T
Aristida longespica	SC	T
Baptisia lactea	White or Prairie False Indigo	SC
Carex festucacea	Fescue Sedge	SC
Clemmys guttata	Spotted Turtle	T
Delta	Geographical Feature	
Fimbristylis puberula	Chestnut Sedge	X
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E
Polygala cruciata	Cross-leaved Milkwort	SC
Polygala incarnata	Pink Milkwort	X
Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	X
Ranunculus ambigens	Spearwort	T

Swan Creek

Scientific Name	Common Name	State Status
Clemmys guttata	Spotted Turtle	T
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

TABLE 1-9: WATERSHED STATUS OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES
(CURRENT AS OF 01/04/2005)

Beaubien Creek

Scientific Name	Common Name	State Status
Ranunculus rhomboideus	Prairie Buttercup	T
Scleria pauciflora	Few-flowered Nut-rush	E
Triplasis purpurea	Sand Grass	SC

Palms Road Drain

Scientific Name	Common Name	State Status
Ranunculus rhomboideus	Prairie Buttercup	T
Scleria pauciflora	Few-flowered Nut-rush	E
Triplasis purpurea	Sand Grass	SC

Marsac Creek

Scientific Name	Common Name	State Status
Clemmys guttata	Spotted Turtle	T
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

Crapau Creek

Scientific Name	Common Name	State Status
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

Goulette Point Drainage

Scientific Name	Common Name	State Status
Hiodon tergisus	Mooneye	T
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

Salt River

Scientific Name	Common Name	State Status
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

Anchor Harbor Drainage

Scientific Name	Common Name	State Status
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E

Auvase Drain

Scientific Name	Common Name	State Status
Armoracia lacustris	Lake Cress	T
Macrhybopsis storeriana	Silver Chub	SC
Obovaria subrotunda	Round Hickorynut	E
Quercus shumardii	Shumard's oak	SC

Anchor Bay Shores Drainage

Scientific Name	Common Name	State Status
Accipiter cooperii	Cooper's Hawk	SC
Circus cyaneus	Northern Harrier	SC
Elaphe vulpina gloydi	Eastern Fox Snake	T

TABLE 1-9: WATERSHED STATUS OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES
(CURRENT AS OF 01/04/2005)

Anchor Bay Shores Drainage

Scientific Name	Common Name	State Status
Nycticorax nycticorax	Black-crowned Night-heron	SC
Obovaria subrotunda	Round Hickorynut	E

1.2 DESIGNATED, BENEFICIAL, AND DESIRED USES

1.2.1 INTERNATIONAL JOINT COMMISSION (IJC) BENEFICIAL AND DESIGNATED USES FOR WATERWAYS

The MDEQ and the IJC for the Great Lakes and Connecting Channels has established 17 Beneficial and Designated Uses for waterways. Of the 17, the following 7 are considered to be impaired within Anchor Bay and/or its Watershed:

1. Total body contact
2. Partial body contact
3. Warmwater/coldwater fishery
4. Indigenous aquatic life and wildlife
5. Degradation of benthos
6. Degradation of aesthetics
7. Eutrophication impacts and excessive aquatic plant growth.

1.2.2 STATE DESIGNATED USES

The State has developed WQS under Part 4 of the Administrative Rules issued pursuant to Part 31 of the Natural Resources and Environmental Protection Act (1994 PA451, as amended). Rule 100 (R323.1100) of the WQS states that all surface waters of the State are designated for, and shall be protected for, all of the following eight uses:

- Agriculture
- Industrial water supply
- Public water supply at the point of intake
- Navigation
- Warmwater fishery (Lake St. Clair is also designated as a coldwater fishery)
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

The status of a designated use in a watershed can be unimpaired, impaired, threatened, or under review/unknown. The use is unimpaired if the available physical and analytical data indicates that all applicable WQS are being consistently met. If the available physical and analytical data indicates that WQS are not being consistently met, then the designated use is considered to be impaired. A threatened status occurs when a watershed is currently unimpaired but could become impaired due to: 1) actual and/or projected land use changes and/or, 2) declining water quality trends, as shown by physical or analytical data.

A use that is designated as under review or unknown means there is insufficient physical or analytical data available to determine a status for the use, and additional studies are necessary.

Table 1-10 lists the designated and beneficial uses for all watersheds and the current impairments status in Anchor Bay and the Watershed. The table differentiates between the impairment status in Anchor Bay and impairment status in the Watershed because these areas may have a different status for a particular designated use.

TABLE 1-10: IMPAIRMENTS OF DESIGNED AND BENEFICIAL USES

Designated (D) and Beneficial (B) Use Determinations	Impairment Status (k) = known (s) = suspected	
	Anchor Bay	**Anchor Bay Watershed**
Partial body contact (D), (B)	Impaired by elevated *E. coli* concentrations (k)	Impaired by elevated *E. coli* concentrations (k)
Total body contact between May 1 and October 31 (D), (B)	Impaired by elevated *E. coli* concentrations (k)	Impaired by elevated *E. coli* concentrations (k)
Degradation of aesthetics (B)	Impaired by excessive aquatic plant growth (k)	Impaired by excessive nutrients and sediment (s)
Indigenous aquatic life and wildlife (D), (B)	Impaired by loss of habitat (k)	Impaired by loss of habitat (k)
Eutrophication or undesirable algae (B)	Impaired by excessive aquatic plant growth (k)	Impaired by excessive nutrients (s)
Warmwater/coldwater fisheries (B), (D)	Not impaired	Impaired by loss of habitat (k)
Degradation of benthos (B)	Impaired by loss of habitat (k)	Impaired by loss of habitat in tributaries (s)
Public water supply at point of intake (D), (B)	Threatened	Threatened
Agriculture (D), (B)	Not impaired	Not impaired
Industrial water supply (D),(B)	Not impaired	Not impaired
Navigation (D)	Not impaired	Not impaired
Degradation of phytoplankton and zooplankton populations (B)	Unknown	Unknown
Restrictions on dredging activities (B)	Not impaired	Not impaired
Bird or animal deformities, reproductive problems (B)	Unknown	Unknown
Fish tumors or other deformities (B)	Unknown	Unknown
Degradation of fish and wildlife populations (B)	Unknown	Unknown
Tainting of fish or wildlife flavor (B)	Not impaired	Not impaired

1.2.3 GREAT LAKES WATER QUALITY AGREEMENT BENEFICIAL USES

Annex 2 of the 1987 Protocol of the Great Lakes Water Quality Agreement between the United States and Canada established 14 beneficial uses to evaluate changes in the chemical, physical, or biological integrity of the Great Lakes System. Annex 2 defined beneficial uses as a method for evaluation rather than as a listed use. If a body of water showed any of the following impacts, then one or more of the beneficial uses was considered to be impaired:

- Restrictions on fish and wildlife consumption
- Tainting of fish and wildlife flavor
- Degradation of fish and wildlife populations
- Fish tumors and other deformities
- Bird or animal deformities or reproduction problems
- Degradation of benthos
- Restrictions on dredging activities
- Eutrophication or undesirable algae
- Restrictions on drinking water consumption, or taste and odor problems
- Beach closings
- Degradation of aesthetics
- Added costs to agriculture and or industry
- Degradation of phytoplankton and zooplankton populations
- Loss of fish and wildlife habitat

All the designated and beneficial uses must be evaluated when developing a watershed plan. As can be seen by comparing the above list with the list of designated and beneficial uses in Table 1-10, there are many overlaps between the two lists.

As with the designated uses, beneficial use status can be unimpaired, impaired, threatened, or under review/unknown. The status definitions for designated uses also apply to beneficial uses.

Beach closings offer an example of how government officials apply these definitions. If beaches are closed for water quality reasons, then the use, which would be similar to total body contact, would be impaired. If beaches are not being closed due to water quality reasons, the use is unimpaired. If changes in the tributary area might affect the beach and cause degraded water quality, then the use is threatened. Lastly, if there is insufficient data available to determine if beach closings are a problem, the status is considered to be under review/unknown.

DESIRED USES AND CONCERNS

Desired uses are defined as how stakeholders might want to use the watershed or how they might like the watershed to look. These desired uses are often reflective of designated or beneficial uses but can be beyond the scope of one of the defined uses, such as the construction of a nature trail within the watershed.

The desired uses were established in the Watershed by polling public officials, the general public, and agricultural producers. A combination of public and steering committee meetings were held to determine the desired uses and concerns that they felt needed to be addressed in the WMP.

In addition to a pre-selected list of desired uses that the respondents were asked to rank, the questionnaire also asked for any additional concerns the respondent might have regarding the Watershed. These concerns are listed in order of priority in Table 1-11.

TABLE 1-11: CONCERNS AND DESIRED USES

General Public Meeting 01/23/2002 Ira Township	Public Officials Meeting 01/23/2002 Ira Township	Agricultural Producers Meeting 04/09/2002 Lenox Township Hall	Watershed-wide Stakeholders Poll (94 responses) 06/19/2002 thru 09/25/2002
Concerns and Desired Uses (in order of decreasing priority)			
Fishing	Healthy drinking water	Lack of open space	Remove sources of human waste in Anchor Bay that threaten public health
Swimming	Fishing	Unmanaged development	
Healthy drinking water	Educating the public	Lack of government support for agricultural buffer strips	Better control sources of fertilizer reaching Anchor Bay and the Great Lakes
Erosion	Swimming		
Recreation	Erosion		
Waterfowl and wildlife habitat	Flooding	Lack of consistent application of agricultural BMPs	Improve habitat conditions for fish and wildlife in the water
Educating the public	Recreation		Increase community planning to address development and protection of water quality
Additional Concerns: Zebra mussels, aquatic weeds, boating, lack of biking and walking trails, construction site erosion, fishing access, and the North Channel dredging	**Additional Concerns:** New Baltimore Park Beach closing, contaminants, bacteria, sewage disposal, development and sewage disposal on Harsens Island and outer islands		Better control soil erosion and limit sediments entering the water Remove paper, trash, and debris in the bay and its tributaries to improve its appearance Encourage investments in land along water for recreation/wildlife protection Expand public education about the benefits of protecting Anchor Bay

CHAPTER 2 - PUBLIC PARTICIPATION AND EDUCATION STRATEGY

2.1 PUBLIC PARTICIPATION PROCESS

Administrative, Steering, and Technical Committees provided oversight and guidance in the implementation of public participation activities. The following description of public participation activities reflects efforts made to develop the original Watershed Management Plan (WMP) between 2001 and 2003, and revisions made to the WMP between 2004 and 2005.

The first Anchor Bay Watershed Project (Watershed Project) meeting was held in September 2001, to solicit interest and participation from Anchor Bay Watershed (Watershed) communities. Since that time, the Steering Committee, made up of local governmental representatives, has provided input and decision making guidance to the project through meetings occurring approximately every other month. These meetings provided a forum to discuss all aspects of the development and implementation of the WMP. In addition, public meetings, a public interest survey, and individual meetings between the project consultant and local communities and county agencies provided input from stakeholders representing a variety of additional interest groups outside the Steering Committee.

In December 2002, the WMP was completed, but the Steering Committee decided that it still needed revisions and individual community review. To address this concern, a Technical Committee was established to revise the WMP and ensure additional community review. The Technical Committee, a total of seven representatives from St. Clair and Macomb Counties, and local communities, and the Michigan Department of Environmental Quality (MDEQ), provided input as each chapter was revised and reorganized. Technical Committee members also met with each community to receive comments concerning the goals and/or the Best Management Practices (BMPs) listed in the WMP. As each chapter was completed, it was presented to the Steering Committee for review and comment. Once revisions of the entire WMP were completed, presentations were made available to municipal and county boards to gain additional support from the communities and counties involved. In December 2003, the WMP was approved by the Steering Committee, and the MDEQ approved the WMP for Clean Michigan Initiative (CMI) funding in 2004.

Between 2004 and 2005, the Watershed Project reviewed the entire WMP to incorporate new field data regarding pollutants, sources and causes, and upgrade the plan to U.S. Environmental Protection Agency (EPA) 319 funding standards. Technical, Evaluation, and Public Education Committees were formed to review and revise various portions of the WMP. Each chapter was presented to the Steering Committee and members were given time for review and comments. Two public meetings were also held to present the revised WMP and a hydrology project to the public.

Members of the Administrative, Steering, and Technical Committees, who were instrumental in developing the original WMP, are listed in Tables 2-1, 2-2, and 2-3, respectively. These committees were continued and other committees were formed to guide the 2004 revisions of the WMP to meet the requirements of the EPA. The committee members who participated on the Technical, Evaluation, and Education Committees are listed in Tables 2-4, 2-5, and 2-6, respectively.

TABLE 2-1: 2003 ANCHOR BAY WATERSHED PLAN ADMINISTRATIVE COMMITTEE

ORGANIZATION	REPRESENTATIVE(S)		
St. Clair County (SCC) Drain Commissioner's Office	Mr. Fred Fuller, Drain Commissioner 21 Airport Drive St. Clair, MI 48079 810-364-5369 ffuller@stclaircounty.org		
SCC Metropolitan Planning Commission	Mr. Gordon Ruttan, Director 200 Grand River Avenue Suite 202 Port Huron, MI 48060 810-989-6950 gruttan@stclaircounty.org	Mr. Geoffrey Donaldson, Environmental Planner 200 Grand River Avenue Suite 202 Port Huron, MI 48060 810-989-6950 gdonaldson@stclaircounty.org	
SCC Health Department	Mr. Ron Miller, Director Environmental Health 3415 28th Street Port Huron, MI 48060 810-987-5306 rmiller@stclaircounty.org	Ms. Kristen O'Reilly, Storm Water Coordinator Environmental Health 3415 28th Street Port Huron, MI 48060 810-987-5306 koreilly@hd.stclaircounty.org	
Macomb County (MC) Public Works Office	Mr. William Misterovich, Deputy Commissioner 115 South Groesbeck Highway Mount Clemens, MI 48043 586-469-5910	Ms. Lynne Seymour, Environmental Engineer 115 South Groesbeck Highway Mount Clemens, MI 48043 586-469-5910 lynne.seymour@co.macomb.mi.us	Ms. Lara Sucharski, Soil Erosion Supervisor 115 South Groesbeck Highway Mount Clemens, MI 48043 586-469-5910 lara.sucharski@co.macomb.mi.us
MC Health Department	Mr. Thomas Kalkofen, Director 43525 Elizabeth Road Mount Clemens, MI 48043 586-569-5219 tom.kalkofen@co.macomb.mi.us	Ms. Vicky Hartingh 43525 Elizabeth Road Mount Clemens, MI 48043 586-569-5219 vicky.hartingh@co.macomb.mi.us	Mr. Gary White, Deputy Director Environmental Health Services 43525 Elizabeth Road Mount Clemens, MI 48043 586-469-5236 gary.white@co.macomb.mi.us
MC Department of Planning and Economic Development	Mr. Steve Cassin 1 South Main Mount Clemens, MI 48043 586-469-5285 stephen.cassin@co.macomb.mi.us	Mr. John Crumm 1 South Main Mount Clemens, MI 48043 586-469-5285 john.crumm@co.macomb.mi.us	

TABLE 2-2: 2003 ANCHOR BAY WATERSHED PROJECT STEERING COMMITTEE*

ORGANIZATION	REPRESENTATIVE (S)		
City of Algonac	Mr. Paul Jarmolowicz, DPW Superintendent 805 St. Clair River Drive Algonac, MI 48001 810-794-5451 dpw@i-is.com	Mr. Mike Harrington Johnson & Anderson 3910 Lapeer Road Port Huron, MI 48060 810-987-7820	
Casco Township	Ms. Karen Holk, Supervisor 4512 Meldrum Road Richmond, MI 48064 586-727-7524 cascostclair@yahoo.com	Mr. Bill Ruemenapp, Township Planner 4512 Meldrum Road Richmond, MI 48064 586-727-8170 cascostclair@yahoo.com	
Chesterfield Township	Mr. Jim Ellis, Supervisor 47275 Sugarbush Road Chesterfield Township, MI 48047 586-949-0400 salexie@chesterfieldtwp.org	Mr. John McCleary, DPW Assistant Superintendent 47275 Sugarbush Road Chesterfield Township, MI 48047 586-949-0400 chesterfieldtwp.org	
China Township	Ms. Linda Schweihofer, Supervisor 4560 Indian Trail China Township, MI 48054 810-765-1145 chinatownship.supervisor@comcast.net	Mr. Ron Beier, Trustee 4560 Indian Trail China Township, MI 48054 810-765-1145	
Clay Township	Mr. Joseph McKoan, Supervisor 4710 Pointe Tremble Algonac, MI 48001 810-794-9303 claytownship.org	Ms. Connie Turner, Treasurer 4710 Pointe Tremble Algonac, MI 48001 810-794-9303 claytownship.org	Mr. Mike Kras, Building Official 4710 Pointe Tremble Algonac, MI 48001 810-794-9320 claytownship.org
Clinton Township	Mr. Robert Cannon, Supervisor 40700 Romeo Plank Clinton Township, MI 48047 586-286-8000	Ms. Mary Bednar, Engineer 40700 Romeo Plank Clinton Township, MI 48047 586-286-9387 mbednar@clintontownship.com	
Cottrellville Township	Mr. Bill Zweng, Supervisor 7008 Marsh Road Marine City, MI 48039 810-765-4730	Ms. Violet Pfaff, Clerk 7008 Marsh Road Marine City, MI 48039 810-765-4730	
Harrison Township	Mr. Mark Knowles, Supervisor 38151 L'Anse Creuse Harrison Township, MI 48045 586-466-1406	Ms. Joy Vallier, Deputy Supervisor 38151 L'Anse Creuse Harrison Township, MI 48045 586-466-1406	
Ira Township	Mr. John Jones**, Supervisor 7085 Meldrum Road Fair Haven, MI 48023 586-725-0263 supervisor@iratownship.org	Mr. Martin Barnes, DPW Superintendent 7085 Meldrum Road Fair Haven, MI 48023 586-725-0263 iratwp@usol.com	
Lenox Township	Mr. John Gardner, Supervisor 63975 Gratiot Lenox, MI 48050 586-727-2085	Mr. Mack Weaver, Trustee 63975 Gratiot Lenox, MI 48050 586-727-2085	Mr. Cam Trombly 59950 Gratiot Lenox, MI 48048 586-749-0230
Macomb Township	Mr. David Koss, Water and Sewer Superintendent 51650 Card Road Macomb, MI 48042 586-598-0687	Mr. Jack Dailey 51650 Card Road Macomb, MI 48042 586-598-0687	
Marine City	Mr. Michael Nagy, City Manager 300 Broadway Marine City, MI 48039 810-765-9011	Mr. Rick Ames, DPW Superintendent 300 Broadway Marine City, MI 48039 810-765-9711	Mr. Bill Klassen 300 Broadway Marine City, MI 48039 810-765-9011

TABLE 2-2: 2003 ANCHOR BAY WATERSHED PROJECT STEERING COMMITTEE*

ORGANIZATION	REPRESENTATIVE (S)		
City of Mount Clemens	Mr. Harry T. Diehl, Mayor One Crocker Boulevard Mount Clemens, MI 48043 586-469-6803	Mr. Chuck Bellmore, Utilities Supervisor One Crocker Boulevard Mount Clemens, MI 48043 586-469-6889	
City of New Baltimore	Mr. Joe Grajek***, Mayor 36535 Green Street New Baltimore, MI 48047 586-725-2151		
Village of New Haven	Ms. Deborah Mack, President 58725 Havenridge New Haven, MI 48048 586-749-5301 villagenh@i-is.com	Mr. Robert Creighton, DPW Director 58725 Havenridge New Haven, MI 48048 586-749-5301	
City of Richmond	Ms. Jan Hunt, Mayor 68225 Main Street Richmond, MI 48062 586-727-7571		
Richmond Township	Mr. Gordon Fuerstenau, Supervisor 34900 School Section Road Richmond, MI 48062 586-727-8998	Ms. Cynthia Greenia 34900 School Section Road Richmond, MI 48062 586-727-8998	

***Members of the Administrative Committee also serve on the Steering Committee.**
****Mr. Jones serves as the Chair of the Steering Committee.**
*****Mr. Grajek serves as the Vice Chair of the Steering Committee.**

TABLE 2-3: 2003 ANCHOR BAY WATERSHED PROJECT TECHNICAL COMMITTEE

ORGANIZATION	REPRESENTATIVE (S)
SCC Health Department	Ms. Kristen O'Reilly, Storm Water Coordinator, Environmental Health 3415 28th Street, Port Huron, MI 48060 810-987-5306 koreilly@stclaircounty.org
SCC Metropolitan Planning Commission	Mr. Geoffrey Donaldson, Environmental Planner 200 Grand River Avenue, Suite 202, Port Huron, MI 48060 810-989-6950 gdonaldson@stclaircounty.org
MC Public Works Office	Ms. Lynne Seymour, Environmental Engineer 115 South Groesbeck Highway, Mount Clemens, MI 48046 586-469-5910 lynne.seymour@co.macomb.mi.us
MC Department of Planning and Economic Development	Mr. Gerard Santoro, AICP, Senior Environmental Planner 1 South Main Street, 7th Floor, Mount Clemens, MI 48043 586-469-5285 gerard.santoro@macombcountymi.gov
Village of New Haven	Mr. Jeff Bednar, Engineer, Anderson, Eckstein & Westrick, Inc., New Haven Representative 51301 Schoenherr Road, Shelby Township, MI 48315 586-726-1234 jbednar@aewinc.com
Townships of Chesterfield, Clay, Harrison, Richmond, and Ira, and the Cities of Mount Clemens and New Baltimore	Mr. Chris McCloed, Planner, Community Planning and Management, Ira Township Representative 48970 Schoenherr Road, Shelby Township, MI 48315 586-247-7500 cpm@eagleguest.com
SEMCOG	Ms. Amy Mangus, Senior Planner 535 Griswold Street, Suite 300, Detroit, MI 48226-3602 313-324-3350 mangus@semcog.org

TABLE 2-4: 2004 TECHNICAL SUBCOMMITTEE

ORGANIZATION	REPRESENTATIVE (S)
SCC Health Department	Ms. Kristen O'Reilly, Storm Water Coordinator, Environmental Health 3415 28th Street Port Huron, MI 48060 810-987-5306 koreilly@stclaircounty.org
SCC Metropolitan Planning Commission	Mr. Geoffrey Donaldson, Environmental Planner 200 Grand River Avenue Suite 202 Port Huron, MI 48060 810-989-6950 gdonaldson@stclaircounty.org
MC Public Works Office	Ms. Lynne Seymour, Environmental Engineer 115 South Groesbeck Highway Mount Clemens, MI 48046 586-469-5910 lynne.seymour@co.macomb.mi.us
SEMCOG	Ms. Amy Mangus, Senior Planner 535 Griswold Street, Suite 300 Detroit, MI 48226-3602 313-324-3350 mangus@semcog.org
Ira Township	Mr. John Jones, Supervisor 7085 Meldrum Road Fair Haven, MI 48023 586-725-0263 supervisor@iratownship.org
MC Department of Planning and Economic Development	Mr. Gerard Santoro, AICP, Senior Environmental Planner 1 South Main Street, 7th Floor Mount Clemens, MI 48043 586-469-5285 gerard.santoro@macombcountymi.gov
Casco Township	Mr. Bill Ruemenapp, Township Planner 4512 Meldrum Road Richmond, MI 48064 586-727-8170 cascostclair@yahoo.com
SCC Drain Commissioner	Mr. Fred Fuller, Drain Commissioner 21 Airport Drive St. Clair, MI 48079 810-364-5369 ffuller@stclaircounty.org
Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H)	Ms. Wendy Ogilvie, Project Consultant 1515 Arboretum Drive, SE Grand Rapids, MI 49546 616-464-3915 ewogilvie@ftch.com

TABLE 2-5: 2004 EVALUATION SUBCOMMITTEE

ORGANIZATION	REPRESENTATIVE (S)
SCC Metro Planning Committee	Mr. Geoff Donaldson, Environmental Planner 200 Grand River Avenue Suite 202 Port Huron, MI 48060 810-989-6950 gdonaldson@stclaircounty.org
Clay Township	Mr. Mike Kras, Building Official 4710 Pointe Tremble Algonac, MI 48001 810-794-9320 claytownship.org
City of Richmond	Mr. Troy Jeschke, Zoning Administrator 68225 Main Street Richmond, MI 48062 586-727-7571 cityplanner@comcast.net
City of New Baltimore	Mr. Craig Higgins, DPW Superintendent 36535 Green Street New Baltimore, MI 48047 586-725-2151 wpcf2004@sbcglobal.net
Chesterfield Township	Mr. John McCleary, DPW Assistant Superintendent 47275 Sugarbush Road Chesterfield Township, MI 48047 586-949-0400 chesterfieldtwp.org
Ira Township	Mr. John Jones, Supervisor 7085 Meldrum Road Fair Haven, MI 48023 586-725-0263 supervisor@iratownship.org
Ira Township	Mr. Eric Barnowski, DPW Assistant 7085 Meldrum Road Fair Haven, MI 48023 586-725-0263 irawater@usol.com
City of Algonac	Mr. Paul Jarmolowicz, DPW Superintendent 805 St. Clair River Drive Algonac, MI 48001 810-794-5451 dpw@i-is.com
FTC&H	Ms. Wendy Ogilvie, Project Consultant 1515 Arboretum Drive, SE Grand Rapids, MI 49546 616-464-3915 ewogilvie@ftch.com

TABLE 2-6: 2004 EDUCATION SUBCOMMITTEE

ORGANIZATION	REPRESENTATIVE (S)
SCC Health Department	Ms. Sheri Faust, Environmental Educator 3415 28th Street Port Huron, MI 48060 810-987-5306 sfaust@hd.stclaircounty.org
SCC Health Department	Ms. Kristen O'Reilly, Storm Water Coordinator Environmental Health 3415 28th Street Port Huron, MI 48060 810-987-5306 koreilly@hd.stclaircounty.org
MC Public Works Office	Ms. Lynne Seymour, Environmental Engineer 115 South Groesbeck Highway Mount Clemens, MI 48046 586-469-5910 lynne.seymour@co.macomb.mi.us
SEMCOG	Ms. Amy Mangus, Senior Planner 535 Griswold Street, Suite 300 Detroit, MI 48226-3602 313-324-3350 mangus@semcog.org
FTC&H	Ms. Wendy Ogilvie, Project Consultant 1515 Arboretum Drive, SE Grand Rapids, MI 49546 616-464-3915 ewogilvie@ftch.com

2.1.1 PUBLIC MEETINGS AND PUBLIC INTEREST SURVEY, WMP 2003

Pubic meetings and a public interest survey were all used to solicit public input during the development of the WMP. Input was received by people representing governmental agencies, environmental groups, remedial action plan groups, agricultural producers, wildlife groups, boating associations, marinas, local businesses, and public schools. A summary of each public meeting, including the complete list of concerns by meeting participants, and the results of the public interest survey is presented in this section.

At a public meeting held on January 23, 2002, in Ira Township, public officials and a small group of stakeholders were asked to prioritize their water quality concerns in Anchor Bay.

Public Meeting - January 23, 2002, Ira Township

	Various Stakeholders	*Governmental Officials*
Prioritized Concerns (in order of priority)	Fishing Swimming Healthy drinking water Educating the public Recreation Wildlife habitat Erosion Flooding	Healthy drinking water Fishing Educating the public Flooding Erosion Swimming Recreation
Additional Concerns	Zebra mussels Aquatic weeds Lack of biking and walking trails Construction site erosion Fishing access, and North Channel dredging	New Baltimore Beach closings Bacteria, sewage disposal Drinking water, sewage disposal, and development on Harsens Island, and outer islands

On April 9, 2002, in Lenox Township, a presentation of the watershed planning process and information gathered to date was made to a group of agricultural producers. This is significant because 36 % of the land use in the Watershed is dedicated to agriculture. Following are some of the concerns expressed at that meeting:

Agricultural Public Meeting - April 9, 2002, Lenox Township

Concerns	Lack of open space
(not in order of priority)	Overdevelopment or unmanaged development
	Lack of government support for agricultural buffer strips
	Lack of consistent application of agricultural BMPs

As chapters of the 2003 WMP were completed, presentations were made to stakeholders on June 19, 2002, in Chesterfield Township and August 28, 2002, in Ira Township. The stakeholders at the June 19 meeting were asked to distribute the Watershed Survey of Issues and Concerns and to help plan a general public meeting to be held on September 25, 2002, at Anchor Bay High School in New Baltimore. Participants distributed advertisements for the September 25 meeting as well as public interest surveys at municipal buildings, local schools, real estate offices, various businesses, township and city meetings, and on the Anchor Bay website.

On September 25, 2002, approximately 50 people attended a public meeting at the Anchor Bay High School in New Baltimore. The meeting consisted of a presentation on the draft of the original Anchor Bay WMP, the Illicit Discharge Elimination Program (IDEP), and Phase II Storm Water Permit Regulations. Participants were divided into groups to discuss various storm water issues addressed in the WMP, such as habitat, soil erosion, sewage, water quality education, and runoff from lawns, yards, and agricultural fields. All groups were asked to devise a water quality budget to address storm water management issues in Anchor Bay. Participants said they would concentrate their resources on the following in order of priority:

Public Meeting - September 25, 2002, New Baltimore

Prioritized Actions	Reduce bacterial inputs
(in order of priority)	Reduce storm water flows
	Preserve and increase habitat
	Reduce sediment loads
	Enhance recreational activities
	Reduce runoff from lawns, yards, and agricultural fields

Approximately four months after the June 19, 2002, public meeting, 94 surveys had been returned from stakeholders representing 14 watershed communities and the results were as follows:

Public Interest Survey - June through September 2002

Prioritized	Remove sources of human waste in Anchor Bay that threaten public health

Public Interest Survey - June through September 2002

Concerns (In order of importance)	Better control the sources of fertilizer reaching Anchor Bay and the Great Lakes Improve habitat conditions for fish and wildlife in the water Increase community planning to address development and protection of water quality Better control of soil erosion and limit sediments entering the water Remove paper, trash, and debris in Anchor Bay and its tributaries to improve its appearance Encourage investments in land along waterways for recreation and wildlife protection Expand public education about the benefits of protecting Anchor Bay Minimize excessive flows that cause flooding, bank erosion, and habitat loss
Issues Most Important	High bacteria levels Water quality Wetland protection
Topics of Interest for Future Mailings	Fish and wildlife Water quality and bacteria levels

Throughout the aforementioned public involvement process, it became clear that the number one concern for Anchor Bay stakeholders is the bacteria sources that affect activities such as swimming and fishing and the number two concern was the need for protection of unique habitats and open space such as remaining wetlands and forested land. Almost all stakeholders, who were surveyed or attended public meetings, agreed that the public needs more education regarding illicit discharges and the overuse of fertilizers. The input from public officials, Watershed residents, and stakeholder groups was a primary consideration when evaluating the water quality impairments in the Watershed and is reflected in the goals and objectives of this plan.

2.1.2 WMP REVISIONS 2005

In 2004, the Watershed Project received a grant to upgrade the WMP to Federal 319 funding standards and implement a WMP. More detailed information about pollutants, sources, loadings, and the hydrology was gained from the grant project and formed the basis of revisions made to the WMP. New Technical, Public Education, and Evaluation Subcommittees were developed for the purposes of providing detailed feedback as the consultant made changes to the WMP. Revisions were presented to the Steering Committee and a comment period was allowed for feedback. Feedback was received through both the Steering Committees and individually and changes became part of the current WMP.

On May 26, 2005, Clay and Chesterfield Townships held two public meetings to communicate the WMP updates and hydrology project results. Efforts to promote watershed efforts and solicit public input at these meetings were made by sending direct invitations and meeting notice fliers to riparian land owners along the subwatershed tributaries and to local municipal officials, press releases to local newspaper, and by providing kids activities and food. The meetings were also videotaped for future playing on local cable stations in both Macomb and St. Clair Counties.

2.1.3 ANCHOR BAY WEBSITE

A project website was established as a mechanism to keep Anchor Bay stakeholders informed during the Watershed planning process. The website was operational in September 2002, and is accessible from St. Clair County's website: http://awp.stclaircounty.org/plan.html. Direct links to this website are also available from St. Clair County and the Clinton River Watershed Council's websites. Publicity of the Anchor Bay website has included reference in newspaper articles, posters, flyers, and presentations during the WMP process.

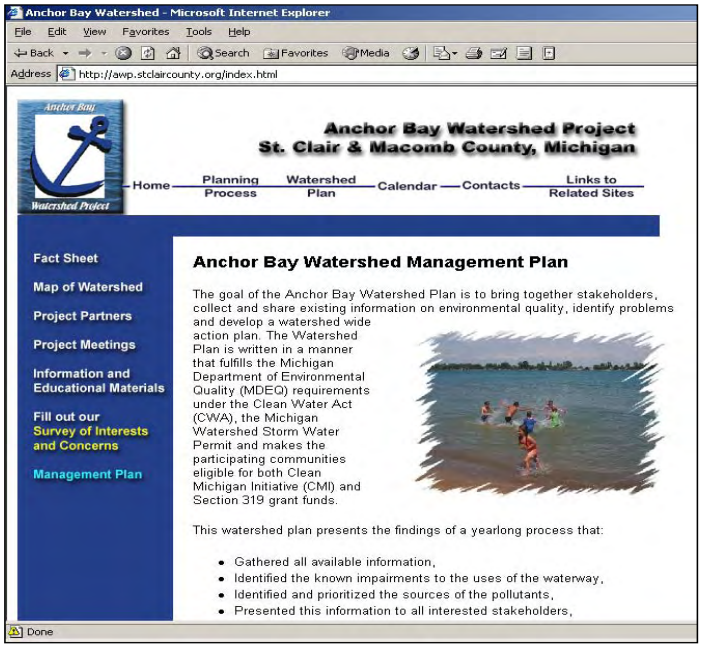

Figure 2-1: Website Homepage

The website has allowed the public to access draft copies of the WMP as it was developed, the completed WMP once it was approved for CMI funding in 2003, a Watershed fact sheet, the Watershed Survey of Issues and Concerns, and names of Stakeholder representatives (Figure 2-1).

The project website remains active and was revised in 2005 to include updated information, the 2005 WMP, and a description of the 2004 grant funded Hydrology Project.

2.2 EDUCATION STRATEGY

The Information and Education Strategy was developed to help Watershed entities minimize priority pollutant sources within the Watershed through outreach and education efforts. The strategy aims to accomplish this by promoting a better awareness of priority pollutant problems and the solutions that can be used to improve water quality. The original Public Education Strategy was developed through a series of Technical and Steering Committee meetings and was approved by the Steering Committee in 2003.

The top four education issues identified in the 2003 Public Education Strategy were:

1. Bacteria Control
2. Sediment Control
3. Fertilizer Management
4. Urban Runoff Management

As part of revisions made to the WMP in 2005, a Public Education Subcommittee (PE Subcommittee) was formed and all revisions were presented to the Steering Committee for approval. The following strategy reflects these revisions. It includes the participating National Pollutant Discharge Elimination System (NPDES) Phase II entities' Public Education Plan (PEP) commitments, their relationship to the priority education issues, the agencies that have education resources to share among Watershed entities, not included in this strategy, and the overall evaluation plan of this education strategy.

2.2.1 PHASE II PEPS

Development of a PEP is one of the requirements of the NPDES Phase II program. These plans were submitted to MDEQ in November 2004, by NPDES Phase II entities. Table 2-7 lists the entities in the Watershed, their NPDES Phase II status, and whether their PEP was submitted to the PE Subcommittee for inclusion in this strategy.

TABLE 2-7: NPDES PHASE II/PEP STATUS

COMMUNITY	NPDES PHASE II	PEP SUBMITTED
St. Clair County	√	√
Casco Township	√	√
Ira Township	√	√
Cottrellville Township	√	√
City of Algonac	√	√
Clay Township	√	√
East China School District	√	√
Macomb County	√	√
City of New Baltimore	√	√
Chesterfield Township	√	√
Lenox Township	√	√
Richmond Township	No	N/A
City of Richmond	No	N/A
Clinton Township	√	Not Submitted
Macomb Township	√	Not Submitted

2.2.2 ACTION STRATEGY

Table 2-8 highlights the common public education materials and activities of those NPDES Phase II entities that submitted their PEPs to the PE Subcommittee in relation to the top four education issues (Bacteria Control, Sediment Control, Fertilizer Management, and Urban Runoff Management) that were originally identified in 2003.

TABLE 2-8: PUBLIC EDUCATION MATERIALS AND ACTIVITIES

	BACTERIA CONTROL	SEDIMENT CONTROL	FERTILIZER MANAGEMENT	URBAN RUNOFF MANAGEMENT
ACTIVITY	**EDUCATION GOALS**			
Watershed/Stream Crossing Signage				X
Children's Activity Booklet				X
River Day Activities				X
Utility Bill Insert		X	X	
Household Hazardous Waste Collection Day/Site	X		X	X
Cable TV Access/Community Billboard	X	X	X	X
Water Quality Presentations	X	X	X	X
Water Quality Display	X	X	X	X
Promote Water Pollution Hotline	X			
Articles in Municipal Newsletter	X	X	X	X
Web Site Information	X	X	X	X
Adopt-A-Stream Program	X	X	X	X
IDEP Brochure	X			
Septic System Brochure	X			
Riparian Land Management Brochure			X	
Beach Monitoring Brochure	X		X	X
Promote MDEQ's Pollution Prevention Programs	X	X	X	X
Southeast Michigan Partners for Clean Water Informational Materials			X	X

Specific implementation schedules of the above activities can be accessed through individual entity PEPs submitted to the MDEQ. Overall, the above activities are planned for implementation within the current permit cycle that lasts until 2008. As can be seen, a substantial number of activities planned for implementation address the top four education issues of the Watershed. The evaluation of these activities and future revisions to this strategy is explained in Section 2.2.4.

2.2.3 EDUCATION RESOURCES TO SHARE AMONG ENTITIES NOT INCLUDED IN THIS STRATEGY

Table 2-9 identifies entities that have education resources and activities available for any community in the Watershed to use, regardless of their participation in the Watershed Project or their NPDES Phase II status. It is recommended that these communities use these resources to address the top four education issues of the Watershed.

TABLE 2-9: ENTITIES AND RESOURCES AVAILABLE

ENTITY	RESOURCES AVAILABLE
SEMCOG	Ours to Protect campaign materials, mass media, public service announcements, municipal newsletter articles
St. Clair County Health Department (SCCHD)	Storm water website, SEMCOG water quality exhibit, children's activity book, Pollution Solutions presentation, River Day coordination, septic, beach, Watershed management, IDEP, and riparian brochures, bi-annual Watershed newsletter, and water pollution hotline
SCC Michigan State University Extension	Adopt-A-Stream program
St. Clair County Road Commission (SCCRC)	Watershed signage installation
SCCRR	Household Hazardous Waste (HHW) collection days/sites
SCCDO	Storm drain labeling
MCPWO	Pollution Solutions and water and the urban environment student presentations Environmentally friendly landscaping workshops, informational brochures Pollution Solutions video, environmental education calendar, and internal newsletters
MaMCRC	Watershed signage installation
CRWC	River Day coordination, Clinton River cleanup, Adopt-A-Stream, storm water education website, information materials and brochures

2.2.4 PUBLIC EDUCATION EVALUATION

The Watershed Steering Committee (Steering Committee) is responsible for evaluating the effectiveness of the education activities toward meeting the Watershed's goals and identified education issues. The Steering Committee will use NPDES Phase II annual reports and a future public education survey to gauge how well the education activities have resulted in knowledge gained and actions implemented by the public. Additional activities implemented by non-Phase II or non-participatory entities will also be reviewed on an annual basis when they are submitted to the PE Subcommittee.

2.3 PUBLIC EDUCATION SURVEY

In 2004, a survey was performed to be statistically significant for the boundaries of the Watershed and provide baseline information regarding the public's current Watershed knowledge and water quality protection actions. This baseline information will be used to gauge the effectiveness of the Watershed's education efforts once a future survey is complete. The exact timing of a future survey is currently unknown, but should be complete by 2010. The findings and future evaluation methods of the survey are included in Table 2-10.

TABLE 2-10: FINDINGS AND FUTURE EVALUATION METHODS

FINDINGS	FUTURE EVALUATIONS
URBAN RUNOFF MANAGEMENT	
89% think the quality of local streams where they live affects the Great Lakes and Lake St. Clair	Maintain current percentage
55% do not know where storm drains lead	Decrease percentage
15% think storm water runoff is the greatest contributor to water pollution	Increase percentage
50% have not taken action to protect water resources in the past two years	Increase percentage of people who take action to protect water quality
FERTILIZER MANAGEMENT	
65% think the way they care for their lawn and home affects the quality of water in lakes and streams in the community where they live	Increase percentage
30% indicate they use fertilizers on their lawn at least three times per year	Decrease percentage or increase their use of low phosphorous fertilizers
61% indicate fertilizer use on the lawn at least once a year	Increase percentage of only one time/year fertilizer use and increase use of low phosphorous fertilizers
83% sweep excess fertilizer/grass clippings into their lawn	Maintain or increase percentage
HHW DISPOSAL	
51% are not using a community collection site for household hazardous waste disposal because they do not know where one was located	Increase knowledge of HHW collection sites
86% dispose of hazardous waste at a community collection day	Maintain or increase percentage

CHAPTER 3 - WATERSHED GOALS AND OBJECTIVES

3.0 LONG-TERM GOALS AND SHORT-TERM OBJECTIVES

The 2003 Watershed Management Plan (WMP) identified the long-term goals and short-term objectives designed to address concerns raised by the public as well as to restore and protect the beneficial uses established under the Great Lakes Water Quality Agreement and the designated uses set by the State of Michigan. These goals and objectives are retained in the 2005 WMP to ensure the decisions and wishes of the community remain.

The goals and objectives are intended to reduce and/or eliminate the impacts of the pollutants within the Anchor Bay Watershed (Watershed). They will not only lead to a reduction and/or elimination of the current impairments, but will also protect water quality and natural habitat in threatened areas. The goals have been developed on a watershed-wide basis. Therefore, no single community is responsible for achieving all of the goals on their own. Rather, communities and counties must work together to implement individual Best Management Practices (BMPs) and collectively achieve objectives that will accomplish these long-term goals.

Implementing and maintaining the listed objectives designed to reach the Watershed goals is a four-step process.

1. Implementing and maintaining BMPs designed to accomplish the objectives and goals.

2. Reviewing and modifying existing projects, programs, and ordinances as necessary.

3. Designing and implementing education and information activities designed to inform the public about the purpose of the BMPs, objectives, and goals, and the role of the public in accomplishing those measures.

4. Evaluating the effectiveness of planned activities associated with implementation of BMPs within the Watershed.

The objectives associated with each of the goals are also developed on a watershed-wide basis and no single community or county is expected to accomplish all the listed objectives. It is anticipated that the participating communities and counties within the Watershed will continuously strive to meet the objectives for each goal through implementation of various BMPs within their jurisdiction and by working collectively with the other Watershed entities. While many of the objectives are already being implemented, additional objectives will be implemented under this WMP and in conjunction with the National Pollutant Discharge Elimination System (NPDES) Phase II storm water permits.

For example, the Macomb County Public Works Office administers the Illicit Discharge Elimination Program (IDEP) as an intensive effort to locate and eliminate illegal connections to the county's storm drain system that could be contributing pollutants to Anchor Bay. The St. Clair County Health Department's Storm Water Program initiated the IDEP to identify and eliminate sources of bacteria contamination in the waterways by tracking down the sources of *E. coli* through systematic sampling and testing of the natural waterways, road ditches, and drains. The first step to eliminating these sources is to find the sources of bacteria, which can be agricultural runoff, illegal sanitary sewer connections, malfunctioning septic systems, and animal waste.

Progress toward meeting the goals will be submitted as part of each community's or county's annual report to the Michigan Department of Environmental Quality (MDEQ) under the NPDES Phase II storm water permits. Progress will be measured against milestones and criteria that have been established as part of the development of this revised WMP. The measurable milestones, criteria, and monitoring plans are detailed in Chapter 6.

Listed below are the long-term goals and short-term objectives, listed in no specific order of priority.

Long-term Goal 1: Restore and enhance recreational uses

Objectives:
- 1a. Reduce bacterial loading
- 1b. Reduce nutrient loading
- 1c. Provide additional public access to water resources

Long-term Goal 2: Restore and protect aquatic life, wildlife, and habitat

Objectives:
- 2a. Protect and re-establish riparian and instream habitat
- 2b. Reduce soil erosion and sedimentation
- 2c. Reduce excess runoff
- 2d. Protect open space and natural areas within the Watershed

Long-term Goal 3: Protect public health

Objectives:
- 3a. Protect drinking water supply
- 3b. Reduce bacterial loading
- 3c. Reduce pollutants resulting in fish advisories

Long-term Goal 4: Reduce impacts from peak flows

Objectives:
- 4a. Establish target peak flows for the tributaries
- 4b. Develop water resource protection and management ordinances to reduce runoff
- 4c. Reduce storm water runoff quantity
- 4d. Minimize post-storm instream flow velocities

Goals were developed based on:

1. The designated and beneficial uses identified as impaired by the MDEQ and the Technical and Steering Committees.
2. The desired uses and concerns identified by the participating public officials and stakeholder groups.

Table 3-1 summarizes the impairment status of the beneficial and designated uses in the Watershed and shows the relationships among the desired uses and concerns of the public in the Watershed and how those uses and concerns relate to the designated and beneficial use determinations. Those uses that are not listed are considered to be unimpaired. The table lists the long-term goals, which are designed to upgrade the impaired designated/beneficial use to an unimpaired status when fully achieved.

TABLE 3-1: GOALS TO MEET DESIGNATED AND BENEFICIAL USES

Designated (D) and Beneficial (B) Use Determinations	Desired Uses and Concerns of the Public	Impairment Status		Long-term Goals
		Anchor Bay	Watershed Area	
C = Concern, I = Impaired, T = Threatened				
Partial body contact (D), (B)	Swimming, recreation, beach closings, sewage	I	I	Restore and enhance recreational uses Protect public health
Total body contact (D), (B)	Swimming, recreation, beach closings, sewage	I	I	Restore and enhance recreational uses Protect public health
Degradation of aesthetics (B)	Flooding, erosion	I	I	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Reduce impacts from peak flows
Indigenous aquatic life and wildlife (D), (B)	Waterfowl and wildlife habitat, flooding	I	I	Restore and protect aquatic life, wildlife, and habitat Reduce impacts from peak flows
Eutrophication or undesirable algae (B)	Swimming, recreation, fishing, waterfowl and wildlife habitat, aquatic weeds, trash removal, control fertilizer runoff	I	I	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Protect public health
Warmwater/coldwater fisheries (B), (D)	Fishing, erosion, flooding	I	I	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Protect public health Reduce impacts from peak flows

TABLE 3-1: GOALS TO MEET DESIGNATED AND BENEFICIAL USES

Designated (D) and Beneficial (B) Use Determinations	Desired Uses and Concerns of the Public	Impairment Status		Long-term Goals
		Anchor Bay	Watershed Area	
C = Concern, I = Impaired, T = Threatened				
Degradation of benthos (B)	Fishing, erosion, flooding		I	Restore and protect aquatic life, wildlife, and habitat Reduce impacts from peak flows
Drinking water (D), (B)	Drinking water	T	No drinking water intake in Watershed	Protect public health
Financial concerns		C	C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Protect public health Reduce impacts from peak flows
Educating the public		C	C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Protect public health Reduce impacts from peak flows
Lack of open space, boating, biking, and walking trails, fishing access, manage riparian land			C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat
Unmanaged development		C	C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat Reduce impacts from peak flows
Lack of governmental support for agricultural buffer strips			C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat
Lack of consistent application of agricultural BMPs			C	Restore and enhance recreational uses Restore and protect aquatic life, wildlife, and habitat
Lack of recreational access		C	C	Restore and enhance recreational uses

CHAPTER 4 - ACTIONS AND BEST MANAGEMENT PRACTICES

The 2003 Watershed Management Plan (WMP) identified many Best Management Practices (BMPs) associated with the goals as recommendations for communities and entities to implement. The revisions to this WMP have combined, categorized, and defined those BMPs to come up with a list of actions and BMPs that relate to each objective, thereby enabling communities and entities to more easily focus efforts on their priorities.

The 2003 WMP recognized that the pollutants identified in the earlier chapters are most often by-products of human impact on the land that makes up the Anchor Bay Watershed (Watershed). In order to protect and restore Anchor Bay and its tributaries, the impact of these human activities must be minimized, either by actions that result in changes in behavior or through the use of BMPs. Actions include policy implementation and educational programs. BMPs are practices selected to address specific environmental issues and can be implemented individually or in a series to address impairments within the Watershed. Some BMPs are better suited to newly developing communities, while others are more applicable to established urban areas. Rural and agricultural BMPs are often dissimilar to urban BMPs, but rely on many of the same concepts.

The many stresses on the environment identified in the earlier chapters can be divided into several broad categories that are closely associated with the major goals of this WMP. Thus, actions and BMPs proposed to be used by the communities have been organized into four long-term goals:

- Goal 1: Restore and enhance recreational uses
- Goal 2: Restore and protect aquatic life, wildlife, and habitat
- Goal 3: Protect public health
- Goal 4: Reduce impacts from peak flows

Actions and BMPs can be structural, vegetative, or managerial practices, and educational programs that reduce sources of pollutants from both urban and rural areas. A list of actions and BMPs was prepared and reviewed by the Anchor Bay Technical Subcommittee (Technical Subcommittee) that included the characteristics to be considered in their selection as an appropriate practice for a particular site. The structural and vegetative BMPs listed in Table 4-1 include practices of pretreatment, detention/retention, vegetated treatment, infiltration, filtration, and agricultural. A similar spreadsheet was developed for managerial and educational actions (Table 4-2), which include practices of agricultural, zoning ordinances/land use policies, recycling/composting, turf management, operations and maintenance, education, and municipal operations. The actions and BMPs to address each specific long-term goal are listed below and are associated with the objectives to meet those goals.

Table 4-1: Structural and Vegetative Best Management Practices

BMP#	BEST MANAGEMENT PRACTICES	DESCRIPTION	POLLUTANT ADDRESSED	POLLUTANT REMOVAL EFFICIENCY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	INSTALLATION COSTS	OPERATION AND MAINTENANCE COSTS	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
1	Cattle Exclusion (NRCS practices: Use Exclusion (472), Fence (382))	Fencing to exclude cattle access and protect the stream. Fencing prevents cattle from trampling banks, destroying vegetation, depositing waste in the stream, and stirring up sediment in the streambed.	Sediment and attached pollutants, nutrients, pathogens	Moderate to high for fencing and use exclusion (12)	Livestock access, animal manure	Buffer/filter strip, alternative water sources, planned grazing system, stream crossing and livestock access	10 years (use exclusion) (15) 20 years (fence) (9)	Repair fence as needed. Remove off-stream watering systems in the winter, if needed.	NRCS available for assistance	Widely applicable	Increased grazing in confined areas may reduce vegetative cover	Fencing in floodplain may catch debris and restrict flow -	$1.90/ft of fence (9) - EQIP (use exclusion) WHIP (fence)	$0.05/ft of fence (9)	Additional BMPs (e.g. Buffer/Filter Strips) are needed to prevent animal waste runoff from entering the stream.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/472.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/382.pdf
1	Agricultural Waste Storage Facility (313)	A waste storage impoundment that protects water bodies from manure runoff by storing manure until conditions are appropriate for field application. Several options exist including an earthen storage pond, above or below ground tank, pit underneath a confinement facility, or a sheltered concrete slab area. Allows for field application when conditions are right. Field application cuts fertilizer costs and reduces nutrient losses.	Nutrients, pathogens	Moderate (organics (12), fertilizers (12), and polluted storm water runoff)	Animal manure	Cattle exclusion fencing, roof runoff management, diversion, Comprehensive Nutrient Management Plan (CNMP)	15 years (15)	Inspect storage structures for leaks or seepage periodically and make necessary repairs. Repair any damaged fences immediately. Empty storage structure twice a year.	NRCS available for assistance	Widely applicable	Leaks or seepage of the structure could add nutrients and bacteria to downstream water bodies via runoff. However, if building is according to specifications this would not occur.	Slight decrease in runoff/ flooding and excess subsurface water	Approximately $10,000 - 250,000 (14) - (12) - EQIP	$250 - 1,000 maximum (14)	Storage period should be 6 months unless winter applied risk index is completed.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/313.pdf
6	Composting Facility (317)	A facility for the biological stabilization of waste organic material. The purposed is to treat waste organic material biologically by producing a humus-like material that can be recycled as a soil amendment and fertilizer substitute or otherwise utilized in compliance with all laws, rules, and regulations. Keeps organic debris out of surface waters and away from floodplains will help prevent the depletion of oxygen in surface waters.	Nutrients, low DO	?	Upland source (yard trimmings and kitchen waste)	NA	15 years / composting facility (2004)	Composting requires proper aeration, watering and mixing in order to result in a useable end-product. Product can be sold, delivered, and applied.	Design and installation should be done by a professional	Widely applicable to dense residential or riparian sites. Soils, topography and climate will all affect the types of composting options available.	Waste needs to be composted and correctly applied as fertilizer. Possibility of runoff of compost application contaminating surface waters.	NA	$37,000/ composting facility (2004)	Annual Maintenance: $370/ year /composting facility (2004)	As of March 27, 1993, yard waste collected or generated in Michigan on public property is banned from land fills and incinerators.		
8	Vegetated Buffers or Filter Strips (NRCS Practice 393)	A buffer/filter strip is a vegetated area adjacent to a water body. The buffer/filter area may be natural, undeveloped land where the existing vegetation is left intact, or it may be land planted with vegetation. Practice protects water bodies from pollutants such as sediment, nutrients and organic matter, prevents erosion, provides shade, leaf litter, and woody debris. Buffer/filter strips often provide several benefits to wildlife, such as travel corridors, nesting sites and food sources.	Sediment and attached pollutants, nutrients, thermal pollution	High to Moderate (streambank erosion) (12) Insignificant (runoff/ flooding) (12)	Runoff from parking lots, roof tops, and outflow from ponds, soil erosion, agricultural runoff	Conservation tillage in agricultural areas	10-20 years (9)	Low. Perform periodic inspections to identify concentrated flows and to verify that vegetative cover is maintaining its effectiveness. Address stream bank erosion if identified. Damaged areas should be repaired.	Low. NRCS available for assistance	Widely applicable		Will reduce the velocity of storm water runoff and increase infiltration.	Low. $350/acre (10). $250/ herbaceous acre (11) - CRP, EQIP	Low. $10/acre (9)	Several researchers have measured >90% reductions in sediment and nitrate concentrations; buffer/filter strips do a reasonably good job of removing phosphorus attached to sediment, but are relatively ineffective in removing dissolved phosphorus (Gilliam, 1994).		http://www.deq.state.mi.us/documents/deq-swq-nps-bfs.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/393.pdf
8	Forested or Wooded Riparian Buffer (NRCS practice 390)	Forested or wooded areas adjacent to stream	Sediment and attached pollutants, nutrients, thermal pollution	High (sheet, rill, wind, streambank, soil mass movement, road bank/construction erosion; organics, fertilizers, pesticides, runoff/ flooding) (12)	Runoff from parking lots, roof tops, and outflow from ponds, soil erosion, storm water runoff	Filter strip	15 years (9)	Low. Perform periodic inspections to identify concentrated flows and to verify that vegetative cover is maintaining its effectiveness. Address stream bank erosion if identified. Damaged areas should be repaired.	Moderate to high. NRCS/MDA available for assistance	Widely applicable	Poor or lack of maintenance may cause increased erosion if trees fall into stream	Trees in the floodplain may catch debris and impede flow.	Low. $475/forrested acre (11) - CRP, EQIP	1% of original cost (11)	Keep south and west sides of streams wooded to provide shade. Several researchers have measured >90% reductions in sediment and nitrate concentrations; buffer/filter strips do a reasonably good job of removing phosphorus attached to sediment, but are relatively ineffective in removing dissolved phosphorus (Gilliam, 1994).		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/390.pdf
10	Check dams, Grade control structures (NRCS practice 410)	Stones, sandbags, or gravel generally used to stabilize grades in natural or artificial channels by carrying runoff from one grade to another. Designed to prevent banks from slumping, reduce runoff velocity, and prevent channel erosion from an excessive grade.	Sediment and attached pollutants, hydrologic flow	High (classic gully erosion) (12) Moderate (streambank erosion) (12) Low (runoff/ flooding) (12)	Streambank erosion, soil erosion, storm water runoff	Buffer/filter strips, grassed waterway, diversion, check dams, critical area planting	20+ years	Low. Periodic inspections. Repair/replace failing structures. Address any vegetation and erosion problems.	Moderate. Design and installation should be done by a registered professional engineer	Widely applicable to erosive areas with an excessive grade. Place in drainage channel.	Concentrated flows may cause erosion downstream - discharge point should be investigated.	Cause backwater effect; slows down water velocities; capacity equal to channel	Low to moderate. $4,650/structure or $800/vegetated chute (9) - EQIP, WHIP	Low. $60/structure (9)	Use native grasses when planting filter strip. Easements or permits may need to be obtained.		http://www.deq.state.mi.us/documents/deq-swq-nps-cd.pdf

Table 4-1: Structural and Vegetative Best Management Practices

BMP#	BEST MANAGEMENT PRACTICES	DESCRIPTION	POLLUTANT ADDRESSED	POLLUTANT REMOVAL EFFICIENCY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	INSTALLATION COSTS	OPERATION AND MAINTENANCE COSTS	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
14	Streambank and Shoreline Protection (580)	Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries. Benefits include: a) Prevents the loss of stream bank vegetation b) Reduces sediment loads to streams c) Maintains the capacity of the stream channel d) Improves or enhances the stream corridor for fish and wildlife habitat, aesthetics, recreation	Sediment and attached pollutants	High (streambank erosion, soil mass movement) (12)	Soil erosion	Geotextile materials (i.e. Filters) are often used underneath Riprap. Consider livestock exclusion, prescribed grazing, buffer/filter strips, diversions, or additional sediment control measures.	20 years (9)	Site inspections, conducted to ensure the stream bank structures are staying in place, within the first few months of installation and following storm events.	Consult the MDEQ (Water Division or Land Division), local Conservation District, NRCS, or other agencies or consultants.	Widely applicable: site-specific practices will depend on soil type, slope of the bank, river gradient, flow, and uses of the watercourse.		Maintains the capacity of the stream channel.	EQIP: 50% cost share (15)	10% of original cost (11)	Since each reach of a watercourse is unique, stream bank protection techniques must be selected on a site-by-site basis; the specifications for each technique differ. Utilize vegetative species that are native and/or compatible with local ecosystems.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/580.pdf
14	Stabilized Outlets	Outlets are areas which receive discharge water. Stabilized outlets are outlets which reduce the velocity of discharge water to non-erosive velocities. Stabilized outlets help reduce erosion in the area in which the water is released. Some outlets may also provide treatment of various types of pollutants depending on the type of outlet used. Types of outlets include the following: Conveyance Outlets (Grassed Waterway, Stone Filters, Stormwater Conveyance Channel), Water Storage Outlets (Sediment Basin, Infiltration Basin, Detention/ Retention Basin, Oil/Grit Separators, Wet ponds and wetlands), Conduits, and Outlet Protection.	Sediment and attached pollutants, hydrologic flow	Dependent on type of outlet used.	Storm water runoff, streambank erosion	Riprap, if needed	Dependent on type of outlet used.	All of the BMPs cited in the section above require regular maintenance. Follow the maintenance sections in the outlet (BMP) selected.	Stabilized outlets should be designed by registered professional engineers.	Widely applicable.	If practices are not maintained, excessive sediment may be introduced to surface waters downstream.	Practice will reduce the velocity of discharge water to non-erosive velocities.	Dependent on type of outlet used.	Dependent on type of outlet used.	If the outlet is a county or inter county drain, permission to discharge must be obtained from the drain commissioner or drain board. The actual structure may require a MDNR permit if the outlet is in a watercourse or if wetlands are impacted.		www.deq.state.mi.us/documents/deq-swq-nps-so.pdf
14	Riprap	A permanent cover of rock used to stabilize stream banks, provide in-stream channel stability, and provide a stabilized outlet below concentrated flows. The use of riprap protects stream banks and discharge channels from higher erosive flow velocities and decreases sediment input to a watercourse.	Sediment and attached pollutants	High	Soil erosion, agricultural runoff	Filters. (Riprap is often used in making Stabilized Outlets, in Stream bank Stabilization, etc.)	10 + years (SV)	Low - Periodically inspect underlying fabric, adjust and add riprap as needed.	Low - consult technical resources	Widely applicable: Riprap is most often used in stream banks, on slopes, and at outlets.	Potential to cause additional erosion downstream.	Reduces downcutting and lateral cutting of erosive flow velocities. Typically not a significant velocity reducer.	$70/square yard (2003b) Including geotextile	?	An MDEQ permit may be required if placed in waters of the state. Explore downstream impacts.		
17	Restored Wetland (NRCS practice 657)	A rehabilitation of a drained or degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural condition to the extent practicable. Provides natural pollution control by removing pollutants, filtering and collecting sediment, reducing both soil erosion and downstream flooding, and recharging groundwater supplies.	Sediment and attached pollutants, nutrients, hydrologic flow, bacteria, chemicals (pesticides)	Moderate to high (depending on season); 80% of total suspended solids from sheet, rill, wind, or ephemeral gully erosion (4) 50% of total phosphorous (4).	Storm water runoff, soil erosion	Sediment forebay or other form of pretreatment. In agricultural areas cattle exclusion fencing, buffer/filter strip, grassed waterway	50+ years (1)	High; Remove and dispose of sediment, trash and debris, and repair eroded areas.	Moderate to High. Design and installation should be done by a professional	Site must have previously been a wetland	Can increase water temperature. Potential for nutrient release in winter months	Stores storm water and may reduce downstream runoff and flooding. Slows flow and reduces peak flow.	Low: $200 cost to landowner if wildlife organization involved. Break tile and build berm. $2,350/acre (swamp)	3% of original cost (11)	Many wetlands release water slowly into the ground which recharges groundwater supplies. One acre of wetland can store up to 1.5 million gallons of floodwater enough to fill 30 Olympic size swimming pools (EPA, 2002)		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/657.pdf
25	Permanent Sediment Basin	Man-made depression in the ground where runoff water is collected and stored to allow suspended solids to settle out. May have inlet and outlet structures to regulate flow.	Sediments, solids	Moderate to high; 50% of Total Suspended Solids(4);<20% of Total Phosphorous (4)	Storm water runoff	Detention/Infiltration	50+ years	Moderate; Remove and dispose of sediment, trash and debris, and repair erosion.	Low	Use for large drainage areas (≥ 1 acre), at storm sewer outfalls, may be included with detention pond, and to collect overland flow.			Low; Capital Cost: $0.60/cft of storage volume excluding land purchase. (1)	7% of capital cost/year. (1)	Not always aesthetically pleasing		http://www.deq.state.mi.us/documents/deq-swq-nps-sb.pdf
25	Ponded Type Detention Basin (wet pond)	Small, man-made basin to maintain a permanent pool of water with emergent wetland vegetation around the bank designed to capture and remove particulate matter, nonsoluble metals, organic matter and nutrients through settling. It generally has inlet and outlet structures to regulate flow.	Sediment; nutrients; flow	Moderate; 80% of total suspended solids (4) 50% of total phosphorous (4). Of the detention/retention basins, this practice may be the most effective in removing pollutants.	Storm water runoff	Sediment forebay or other form of pretreatment, Riprap, Sediment Basin, Filter	50+ years (1,6)	Low; Remove and dispose of sediment, trash and debris, repair erosion; and plant replacement as needed.	Low. Design and installation should be done by a professional	Use for large drainage areas (≥ 10 acre), at storm sewer outfalls, and to collect overland flow. Ponds generally will not work in soils with high infiltration rates.	Possible downstream warming; low bacteria removal; West Nile Virus (aerator can remove threat of West Nile Virus)	Provides full control of peak discharges for large design storms and may help increase low flows - Rural	Low to moderate; $1/cft of storage volume, excluding land purchase (1)	5% of capital cost/year. (1)	Need available land area, can include sediment forebay, requires more planning, maintenance and land to construct.		http://www.deq.state.mi.us/documents/deq-swq-nps-wdb.pdf
25	Dry Detention Basin	Small, man-made basin designed to capture and remove particulate matter. It generally has inlet and outlet structures to regulate flow.	Sediment; flow	Moderate; 80% of total suspended solids (4) 50% of total phosphorous (4)	Storm water runoff	Sediment forebay or other form of pretreatment	50+ years	Low; Remove and dispose of sediment, trash and debris, and repair erosion.	Minimum	Needs land that will allow inlet at a higher elevation than outlet	Low bacteria and nutrient removal. If vegetation is not maintained erosion and resuspension will occur.	Reduced peak flows and no standing water	Low to moderate	Low to moderate	Basin grading very important to prevent pools of standing water.	MDOT	

Table 4-1: Structural and Vegetative Best Management Practices

BMP#	BEST MANAGEMENT PRACTICES	DESCRIPTION	POLLUTANT ADDRESSED	POLLUTANT REMOVAL EFFICIENCY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	INSTALLATION COSTS	OPERATION AND MAINTENANCE COSTS	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
25	Extended Detention Basin	Extended detention basins are designed to receive and detain storm water runoff for a prolonged period of time, typically up to 48 hours. Benefits include: receives and detains storm water runoff, minimizes downstream erosion, reduces flooding, and provides enhanced pollutant removal.	Sediment and attached pollutants, nonsoluble metals, nutrients, hydrologic flow	Moderate to high	Storm water runoff	Riprap, grassed waterways, sediment basins		Moderate to High	Mow buffer/filter strip, remove debris and inspect basin regularly during wet weather, and remove sediment from basin every 5-10 years.	Depends on infiltration rates and soil permeability	Can significantly warm the water in the marsh area over a short period of time	Designed to receive and detain storm water runoff for a prolonged period of time. Outlet device regulates the flow from the basin.			Determine site location of BMP through a hydrologic analysis. Designed as either single-stage or two-stage. Need spill response plan.		http://www.deq.state.mi.us/documents/deq-swq-nps-edb.pdf
25	Parking lot storage	Storage of storm water on parking lots is used primarily to reduce the peak discharge of storm water from the surrounding area during moderate storms. Will reduce peak runoff from small sites and provide some flood storage. This helps reduce stream bank erosion and flooding.	Sediment and attached pollutants, hydrologic flow		Storm water runoff, soil erosion	Grassed Waterway, Modular Pavement, Infiltration Trench, Buffer/Filter Strip, Street Sweeping		Low to Moderate - Sweep and clear debris from the parking lot after storms. Regularly inspect and clean the release drain.	Design and installation should be done by a professional	This BMP will work best in areas that do not have a steep slope. Parking lot slope should be 1% or less.	Because detention time is small only some large solids will settle, which must be removed often to prevent resuspension.	Reduces peak runoff from small sites and provide some flood storage and reduces flooding.			A spill response plan must be developed. BMP is most effective when used with other BMPs that allow for infiltration or sediment trapping.		http://www.deq.state.mi.us/documents/deq-swq-nps-pls.pdf
25	Water and Sediment Control Basin (638)	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin. Improves water quality by trapping sediment on uplands and reducing gully erosion. Grass cover may provide wildlife habitat. Dissolved substances, such as nitrates, may be removed from discharge to downstream areas because of the increased infiltration.	Sediment and attached pollutants, nutrients, hydrologic flow	High (gully erosion) (12) Moderate (runoff/ flooding) (12) Low (streambank erosion) (12)	Soil erosion, agricultural runoff	Nutrient management, terraces, grassed waterways, contouring, conservation cropping system, conservation tillage, and crop residue management	10 years (9)	Reseed and fertilize as needed. Check basins after large storm events and make necessary repairs.	NRCS available for assistance	Widely applicable.	Over application of fertilizer possible.	Traps storm water runoff and prevents it from reaching lowlands. Moderate decrease in runoff/ flooding. Slight increase in excess subsurface water. (12)	$2,100 - 3,150/basin (11)	5% of original cost per unit (11)	Basin must be large enough to control the runoff from a 10-year storm without overtopping.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/638.pdf
25	Regional Detention	Large, man-made basin designed to capture and remove particulate matter. It generally has inlet and outlet structures to regulate flow from large drainage areas.	Sediment; nutrients; flow	Moderate	Storm water runoff	Sediment forebay or other form of pretreatment	50+ years	Low; Remove and dispose of sediment, trash and debris, and repair erosion.	Minimum	Use for large drainage areas (≥ 1 acre), at storm sewer outfalls, and to collect overland flow.	Possible downstream warming; low bacteria removal; West Nile Virus	Reduced peak flows, storage	Moderate	Low to moderate	Need available land area, can include sediment forebay.		
26	Rain Gardens and other "Landscaping for Water Quality" techniques	Small, vegetated depressions used to promote infiltration and evapo-transpiration of storm water runoff. A rain garden combines shrubs, grasses, and flowering perennials in depressions that allow water to pool for only a few days after a rain. Landscaping for water quality involves planting native gardens in place of turf grass using native grasses, sedges, and wildflowers. Protects water quality, captures rainwater, reduces flooding, eases soil erosion, increases infiltration., and requires less fertilizer and water to thrive.	Sediment and attached pollutants, nutrients, thermal pollution, solids, oils, chemicals, oils, salt, flooding	High; 75% - 90% of total suspended solids. (3)(8) 75% of total phosphorous. (8)	Storm water runoff, fertilizers	Master Gardeners Program, Mulching	Assume 25 years, based on rain gardens installed in the early 1990s in Prince George County, MD which are still functioning. Depends on plant types and owner maintenance.	Low - Medium; Remove and dispose of sediment, trash, and debris, repair erosion, re-vegetate, and weed, water, and mulch, annually. Soil replacement and additional preparation are sometimes needed for success. A mulch of shredded hardwood is an integral part of the rain garden to keep the soil moist and ready to soak up rain.	Moderate, initial work to establish plant community. Aesthetic maintenance after initial establishment of rain garden. CES, Master Gardeners Program, WMEAC available for assistance.	Site specific, depends on soils. Use for drainage areas ≤ 5 acres (8), at storm sewer outfalls, and to collect overland flow. Highly suitable for residential areas, not on steep slopes	Introduction of exotic/invasive plant species possible. Landowner may treat vegetation with herbicides or pesticides which could be carried via runoff to surface waters.	Will reduce the velocity of storm water runoff and increase infiltration	$1,075 - $12,355/ rain garden (dependent on surrounding land use)	Low. Assume $100/year (similar to yearly landscaping maintenance)	Use native plant species. Soils adequate for infiltration are required. Cold climates may reduce evapo-transpiration and infiltrative capacity. Practice not suitable for slopes greater than 20% (1). Pretreatment (sediment basin) needed in high sediment load areas. Not used in wellhead protection areas.		
26	Infiltration Trench	An excavated trench (3 - 12 feet deep), backfilled with stone aggregate, and lined with filter fabric (fine particulates should not be routed to this BMP). Infiltration trenches remove fine sediment and the pollutants associated with them.	Nutrients, sediment, metals, hydrologic flow (soluble pollutants - dependent on holding time)	High; 100% of total suspended solids(4); 60% of total phosphorous.	Storm water runoff	Sediment basin, buffer/filter strips, oil/grit separators, filter fabric	Short; 10 years or less (1)	Low to Moderate - Annual; Remove and dispose of sediment, trash and debris. Eroding or barren areas must be revegetated.	Moderate. Design and installation should be done by a professional	Site specific; depends on soils. Soil infiltration rates must be greater than 0.52 inches per hour, with clay content less than 30%.	If storm water runoff contains high amounts of soluble contaminants, groundwater contamination can occur.	Provides full control of peak discharges for small sites, provides groundwater recharge, may augment base stream flow, and allow infiltration.	Moderate; Average $8/cubic feet of storage (1)	9% of capital cost (1)	Avoid areas with potential hazardous material contamination. Soils with high infiltration rates required. Cold climates may hinder infiltrative capacity, fines will clog pore space in soil, and practice is not suitable for steep slopes. Use as part of a "treatment train," where soluble organic substances, oils, and coarse sediment are removed prior to storm water entering the trench. A very high failure rate occurs with infiltration trenches if they are not maintained.	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf
26	Infiltration Pond	Water impoundment over permeable soils which received storm water runoff and contains it until it infiltrates the soils.	Nutrients, sediment, metals	High	Storm water runoff	Sediment forebay or other form of pretreatment	25+ years	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater	May recharge groundwater	Moderate	Moderate	Avoid areas with potential hazardous material contamination	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-ib.pdf
26	Porous or Modular Pavement	Permeable asphalt or interlocking paving blocks providing infiltration. When the brick or concrete is laid on a permeable base, water will be allowed to infiltrate. Benefits include; removal of fine particulates and soluble pollutants; attenuation of peak flows; reduction in the volume of runoff; reduction in soil erosion; and groundwater recharge.	Nutrients, sediment, metals, hydrologic flow	High; 95% TSS removal rate (2)	Storm water runoff	Vacuum sweeping, Subsurface Drains, Extended Detention Basin, Infiltration Basin.	10+ years	Moderate; Bi-annual sweeping required. Periodically inspect, especially after large storms. If severe clogging occurs, may have to replace (clogged) filtering material.	Low. Design and installation should be done by a professional	This practice should only be used on sites with soils which are well or moderately well drained. Must use special materials for high traffic areas	Potential risk to groundwater due to oils, greases, and other substances that may leak onto the pavement and leach into the ground.	Provides soil infiltration, attenuation of peak flows, reduction in the volume of runoff leaving the site and entering storm sewers, and groundwater recharge.	Moderate	Low to moderate	Pre-treatment of storm water is recommended where oil and grease or other potential groundwater contaminants are expected. Avoid areas with potential hazardous material contamination	MDOT	http://www.deq.state.mi.us/documents/deq-swq-nps-pap.pdf

Table 4-1: Structural and Vegetative Best Management Practices

BMP#	BEST MANAGEMENT PRACTICES	DESCRIPTION	POLLUTANT ADDRESSED	POLLUTANT REMOVAL EFFICIENCY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	INSTALLATION COSTS	OPERATION AND MAINTENANCE COSTS	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
27	Catch basin inlet devices	Devices that are inserted into the storm drain inlets to filter or absorb sediment, pollutants, and sometimes oil and grease. The capture of hydrocarbons can be enhanced with the use of absorbents.	Solids, sediments	Moderate to high; 70% of total suspended solids(5); <20% of total phosphorous. Assume same as Hydrodynamic Separators.	Storm water runoff	Catch basin cleaning program	2 - 5 years	High; Remove and dispose of sediment, trash and debris, and change filters as needed (approximately every 6 months)	Low/moderate	Needs less than 5 acres of drainage area	Proper disposal of sediment important		$50 - 1,500 (5)	$300/CB/year (5)	Useful for retrofit	MDOT	
27	Hydrodynamic Separator Units (CDS Units, Stormceptors, Vortechnics, Downstream Defender)	Precast, flow-through, underground units that capture sediments, debris, and oils (in some units). The capture of oils can be enhanced with the use of absorbents. (CDS, Vortechs, Downstream Defender, Stormceptor)	Sediment, solids	Effective; 60% TSS Removal (1); <20% of total phosphorous (4)	Storm sewer system	Street sweeping, stream protection practices	50+	Moderate; Remove and dispose of sediment, trash and debris	Minimum	Use for small drainage areas (≤ 1 acre) with high pollutant loads, in-line with storm sewer system, and to collect overland flow	Proper disposal of sediment important	Catches first flush, high flows by-pass unit through pipe system	High $15,000/acre of impervious (2); 6,000/cfs capacity	$500/practice (2); $1,000/year (3)	Placed upstream of storm sewer discharge. Unit is below grade. Need to allow access for cleaning the chambers.		http://www.deq.state.mi.us/documents/deq-swq-nps-ogs.pdf

(1) Fishbeck, Thompson, Carr & Huber, Inc. Evaluation of Best Management Practices for MDOT. 2002.
(2) Bannerman, Roger T., Wisconsin Department of Natural Resources. Source Area and Regional Storm Water Treatment Practices: Options for Achieving Phase II Retrofit Requirements in Wisconsin. 2002.
(3) Michigan Department of Environmental Quality. Guidebook of Best Management Practices for Michigan.1996.
(4) Environmental Protection Agency (EPA). National Pollutant Removal Performance Database. June 2000.
(5) Personal Communication with Hydro-Compliance Management, Inc. staff. 2004.
(6) Gruenwald, Paul E. Governmental Accounting Focus, Estimating Useful Lives for Capital Assets. May 2002.
(7) Rouge River National Wet Weather Demonstration Project. Planning and Cost Estimating Criteria for Best Management Practices. April, 2001. TR-NPS25.00.
(8) Rain Gardens of West Michigan. Beautiful Solutions for Water Pollution. [Online] 2003. Available at http://www.raingardens.org/Index.php.
(9) USDA - Natural Resources Conservation Service. Field Office Technical Guide, Section 1 Cost Information (draft). 2004.
(10) USDA - Natural Resources Conservation Service. Michigan Area 3 Component Data. June 2003.
(11) USDA - Natural Resources Conservation Service. Sample County Practice and Maintenance Costs. 2001.
(12) USDA - Natural Resources Conservation Service. Conservation Practice Physical Effect Worksheet[s]. 2004.
(13) Personal Communication with Technical Committee of the Lower Grand River Watershed Project. 2004.
(14) Personal Communication with District Conservationist of the NRCS Grand Rapids Service Center. 2004.
(15) USDA - Natural Resources Conservation Service. FY04 Michigan EQIP Statewide Eligible Practice List, Land Management Practices (Incentive Payments). 2004.

Table 4.2: Managerial Best Management Practices

BMP#	BEST MANAGERIAL PRACTICES	DESCRIPTION	BENEFIT	POLLUTANT ADDRESSED	POTENTIAL SOURCES OF POLLUTANTS	ENVIRONMENTAL IMPACTS AND SPECIAL CONCERNS	COMPARATIVE COSTS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
1	Crop Residue Management (329A-C, 344) includes no till, mulch till, ridge till, and seasonal	Leaving last year's crop residue on the surface before and during planting operations provides cover for the soil at a critical time of the year. The residue is left on the surface by reducing tillage operations and turning the soil less. Pieces of crop residue shield soil particles from rain and wind until plants can produce a protective canopy.	Ground cover prevents soil erosion and protects water quality. Residue improves soil tilth and adds organic matter to the soil as it decomposes. Fewer trips and less tillage reduces soil compaction.	Sediment and attached pollutants	Agricultural runoff, soil erosion	Consider if crop will produce enough residue. Planning for residue cover should begin at harvest. Time, energy, and labor savings are possible with fewer tillage trips. Equipment for specialized tillage techniques needed. Additional chemical treatments may be necessary to control pests. Assistance available from USDA office or Conservation District. No local government controls in place. Crop reside reduces the velocity of storm water runoff. Rainfall stays in the crop field allowing the soil to absorb it. Moderate to high decrease in runoff/ flooding.	$28-36/acre (includes no-till and strip till, ridge till) (11). Maintenance costs are 100% of original cost (11). EQIP (for mulch till, ridge till, and seasonal residue management). Equipment rental or purchase $40+ per acre. Consider costs for pest control.		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329a.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329b.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/329c.pdf ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/344.pdf
1	Nutrient Management (590) (Comprehensive Nutrient Management Plan (CNMP)	After taking a soil test, setting realistic yield goals, and taking credit for contributions from previous years' crops and manure applications, crop nutrient needs are determined. Nutrients are then applied at the proper time by the proper application method. Nutrient sources include animal manure, sludge, and commercial fertilizers. Other BMPs include manure testing, soil testing, soil conservation measures, waste management system, waste storage facility, and waste utilization.	This practice properly budgets and supplies nutrients for plant production. It also reduces the potential for nutrients to wash or infiltrate into water supplies by preventing over application. Correct manure and sludge application on all fields can improve soil tilth and organic matter. It is very applicable on Concentrated Animal Feeding Operations (CAFOs).	Nutrients	Agricultural runoff, over application of fertilizers.	Maintenance requirements: - Perform a periodic plan review to determine necessary adjustments - Protect nutrient storage facilities from weather and accidental leakage/ spillage - Calibrate application equipment and document application rates - Spread wastes away from waterbodies on an adequate land base and incorporate ASAP - Analyze manure and other organic waste for nutrient content before field application - Test soils once every three years according to Extension recommendations - Establish a winter cover crop if nitrogen leeching is possible due to poor crop yield * Consider the Michigan Agriculture Environmental Assurance Program (MAEAP). Must be trained technical person to compile a CNMP (service provided by NRCS or Cons. District). Consider potential groundwater contamination - proximity to waterbodies critical.	$5.00/acre (9) - EQIP (Costs associated with waste water collection, soil testing, ICM are low but have a high start up.)		ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/590.pdf
5	Pet waste disposal and collection facilities	Installing signs and pet waste collection facilities in high traffic areas	Moderate	Nutrients, bacteria	Animals, dogs or other household pets				
6	Composting	Converting plant debris, grass, leaves, pruned branches, etc. to compost. Use with lawn maintenance, pesticide and fertilizer management, and diversions (if needed)	Keeping organic debris out of surface waters and away from floodplains. Will help prevent the depletion of oxygen in surface waters. Widely applicable to dense residential or riparian sites. Soils, topography and climate will all affect the types of composting options available.	Nutrients, chemicals, and pesticides, low DO, trash and debris	neighborhoods, agricultural areas, yard, and kitchen waste	Compost piles placed near floodplains will contribute to the depletion of oxygen in surface waters. Composting requires proper aeration, watering and mixing in order to result in a useable end-product. Soils, topography and climate will all affect the types of composting options available.	Recycling vs. garbage hauler costs. Establishment of large scale facility $190,000, land dependant. $70,000 annual maintenance.		
6	Lawn maintenance	Includes mowing, irrigating, pesticide and fertilizer management, soil management and the disposal of organic debris such as lawn clippings and leaves.		Phosphorus, nutrients, and sediments	Landscaping, storm water runoff	Consider minimizing lawn with more native species	Lawn alternatives may reduce mowing but still require regular maintenance of weed control and pert management.		http://www.deq.state.mi.us/documents/deq-swq-nps-lm.pdf
6	Fertilizer management	Includes the proper selection, use, application, storage and disposal of fertilizers. Used with pesticide management, soil management, lawn maintenance, and nutrient management	Moderate; can be other sources	*E. coli* and other bacteria, nutrients	Landscaping, storm water runoff	Consider consulting professional, such as Michigan State University Extension.	Material cost reduction may conflict with traditional aesthetic values. Fertilizer management should reduce chemical costs but may impact maintenance and watering.		http://www.deq.state.mi.us/documents/deq-swq-nps-fm.pdf
6	Soil testing of lawns and gardens	See Soil Management		Nutrients	Lawn and garden fertilizer	Testing should be done at qualified lab	Typically yearly testing required, contact local MSU Extension office. Test results may result in operations and maintenance costs. Low cost tool in management of lawns and gardens. $9.50 per test.		
9	Storm Drain Marking	Affixing plaque on storm drain inlets with "No Dumping" (of such materials as Oil, Pet Waste and Grass Clippings)	Moderate; Educates the general public that the storm drain discharges into a natural waterbody. Can tie into hazardous waste collection, yard waste collection	Hazardous waste and nutrients	Household hazardous waste, motor oil, and yard waste	Volunteers need to take care to properly adhere plaques. Public education campaign is also needed for effective reduction in illegal dumping. Short term effectiveness.	Ceramic tiles $100 or more - metal stencils		
12	Snow and ice control operations and storage	Storage of materials for removal of snow and ice from roadways, utilizing plows, salt, and sand.		Salts	Storm water runoff	Moderate, all storage facilities have standards and specifications.	Moderate. Time for inspection of facilities		

Table 4.2: Managerial Best Management Practices

BMP#	BEST MANAGERIAL PRACTICES	DESCRIPTION	BENEFIT	POLLUTANT ADDRESSED	POTENTIAL SOURCES OF POLLUTANTS	ENVIRONMENTAL IMPACTS AND SPECIAL CONCERNS	COMPARATIVE COSTS	COMMUNITIES USING BMP	MDEQ/ NRCS LINK
12	Calibrated Salt Delivery		Low	Salts	Over application of salt	Calibration does not guarantee efficient application of road salt. Annual training and calibration necessary.	Low upfront cost. Long term equipment maintenance vs. reduced salt. Equipment costs $1500 per truck, minimal additional cost.		
12	Pre wet road salt		High if also used with environmentally friendly alternatives to salt	Salts	Road salt		Low/Moderate; $25/lane/mile, Equipment maintenance costs - $5000 per truck.		
13	SESC programs	Programs that specify the actions that will be taken on a construction site to minimize erosion and sedimentation.	High if properly executed. Reduce erosion and sedimentation during construction project. Increased removal using Floc Logs through construction	Sediment	unvegetated areas, land development	State training, Soil Erosion and Sedimentation Control and/or Certified Operator.	Act 91 mandated, ongoing local administrative costs. Fee based to landowner option.		
15	Street Sweeping	The use of specialized equipment to remove litter, loose gravel, soil, vehicle debris and pollutants, dust, de-icing chemicals, and industrial debris from road surfaces. There are generally 2 types of sweepers; mechanical broom street sweepers and vacuum-type street sweepers.	Moderate; 60% TSS removal rate. Reduction in potential clogging of storm drain material. Some oil and grease control (MDOT). When done regularly, can remove 50 - 90% of street pollutants (1), makes road surfaces less slippery in light rains, improves aesthetics by removing litter, and controls pollutants.	Sediment, metals, hydrocarbons	Atmospheric, construction, vehicles	Sweeping may wash sediments into catch basins if wash is not vacuumed. Disposal of collected materials must be handled by the governing agency (MDEQ, Public Health, Transportation). Sweeping schedules and timing critical - sweep after snow melt and before spring rains. Vehicle maintenance required.	RC Road maintenance budget - $300,000/yr County for Local units. Mechanical - Total cost per curb mile = $14.40 + $65 + $40 = $119.40/curb mile. Vacuum Assisted - Total cost per curb mile = $12.95 + $35 + $40 = $87.95/curb mile (GR BMP Study)		http://www.deq.state.mi.us/documents/deq-swq-nps-sw.pdf
17	Development/Enforcement of Wetland Ordinance	Ordinance promotes a policy to avoid or minimize damage to wetlands and coordinate the planning and zoning process with federal and state programs designed to preserve, protect, or enhance wetland values.	Benefits offered by wetlands are restored. Wetlands provide natural pollution control by removing pollutants, filtering and collecting sediment, reducing both soil erosion and downstream flooding, and recharging groundwater supplies.	Sediment and attached pollutants, hydrologic flow, nutrients, pathogens, chemicals (pesticides), salts	Storm water runoff	Part 303, section 324.30307 authorizes local units of government to adopt and administer their own wetland regulations that address wetlands not protected by the state, provided they are at least as restrictive as state regulations. The DEQ must be notified if a community adopts a wetland ordinance, but it has no review or approval authority.	$11,240 / ordinance development (Corporate sponsored workshops)		
18	Development/Enforcement of Stream Buffer Ordinance	Ordinance protects a given area of buffer adjacent to stream systems. Protected buffers can provide numerous environmental protection and resource management benefits.	Moderate to high. Reduces the risk of sediment and contaminants entering the stream. Practices give a long term solution to water quality concerns.	Sediment and attached pollutants, nutrients, thermal pollution	Storm water runoff from impervious surfaces (e.g. parking lots and roof tops) and outflow from ponds.	Lack of maintenance can increase erosion if trees fall into streams. At a minimum, keep south and west sides of streams wooded to provide shade. Trees in floodway can impede flow.	$11,240 / ordinance development (Corporate sponsored workshops)		
18	Green Space Protection Ordinance - preserving environmentally sensitive and open areas	Can also use filter strips and tree planting to enhance protection.	High if properly executed. Provides protection of natural pollutant removal methods.	Thermal pollution, sediment, nutrients, hydrologic flow	Construction zones, developed parcels, agricultural land		$3/sqft. Land acquisition and management costs depend on site. May double as park/open space usage with related costs.		
19	Yard waste collection and disposal	Composting of collected refuse	Widely applicable to dense residential or riparian sites	Nutrients and organic sediment, trash and debris	Yard waste and leaf litter	Waste needs to be composted and correctly applied as fertilizer. Need large collection facility for compost operations.	Low		
19	Recycling Program (MDOT)	Collection of recyclable materials either by curb-side pick up or at drop off centers	Reduction in potential clogging and harmful discharge	trash, used construction material reuse	Highways, travelers, vehicle debris	Some materials may require more energy to collect and recycle than using new products. However, recycling programs do build awareness	$200,000/year. $1.15/person/yr		
20	Household hazardous waste management	Proper buying, using, storing and disposal of Hazardous materials such as automotive waste, household cleaners and paint.	Moderate: eliminates disincentives and discourages illegal dumping of products into storm sewers and onto the ground	Hazardous wastes	Residents, Used oil, paints, cleaning products, etc	Proper credentials needed for management. Typically consultant based.	Recycling station expenses.		http://www.deq.state.mi.us/documents/deq-swq-nps-hhhw.pdf
22	Illicit Discharge Ordinance (MDOT)	Program to seek out and prohibit illicit discharges and connections to municipal separate storm sewers	High if properly executed. Eliminate hazardous and harmful discharges	Hazardous wastes	Industrial, Residential, commercial		$2/ac (assuming 1 system monitored every 5 sq. miles. Maintenance program. $0.83/acre/year $50/ac/yr (with TV inspection)		
24	Development/Enforcement of Storm Water Ordinance	Ordinance can provide for the regulation and control of storm water runoff; provide for storm water permits an the procedures and standards for the issuance, provide regulations for the inspection, sampling and monitoring of storm water and other discharges; establish performance and design standards for storm water management in specified zones of the Township/Municipality; and provide penalties for the violations of the ordinance.	Storm water runoff rates and volumes are controlled in order to protect floodways. Controls soil erosion and sedimentation; minimizes deterioration of existing watercourses, culverts, bridges, etc.; and encourages groundwater recharge.	Sediment and attached pollutants, hydrologic flow	Storm water runoff	Establishing storm water management control will minimize storm water runoff rates and volumes from identified new land development and encourage groundwater recharge.	$11,240 / ordinance development (Corporate sponsored workshops)		
26	Low Impact Design practices - bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches	Involves careful site planning to reduce the impact to water resources by eliminating impervious surfaces and protecting infiltration areas.	Numerous water quality benefits. Long term solution to concerns.	Thermal pollution, solids, sediments, nutrients, metals	Rainfall, runoff, solar, fertilizers				http://www.lid-stormwater.net/

Table 4.2: Managerial Best Management Practices

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27	Clean and maintain storm inlets and catch basins (MDOT)	Catch basins are periodically inspected and cleaned out using a vacuum truck.	Moderate; Reduces pollutant slugs during the first flush, prevents downstream clogging, and restores sediment trapping capacity of the catch basin.	Solids, sediments, metals, oils	Storm water runoff, automobiles	Requires continual maintenance every 1 - 3 years. General fund, RC road maintenance budget - $250,000	Moderate/high; Total annual cost per catch basin = ($8/catch basin) + ($40/catch basin) = $48/catch basin. (GR BMP Study). $21/acre/year maintenance.		

(1) Fishbeck, Thompson, Carr & Huber, Inc. Evaluation of Best Management Practices for MDOT. 2002.
(2) Bannerman, Roger T., Wisconsin Department of Natural Resources. Source Area and Regional Storm Water Treatment Practices: Options for Achieving Phase II Retrofit Requirements in Wisconsin. 2002.
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(8) Rain Gardens of West Michigan. Beautiful Solutions for Water Pollution. [Online] 2003. Available at http://www.raingardens.org/Index.php.
(9) USDA - Natural Resources Conservation Service. Field Office Technical Guide, Section 1 Cost Information (draft). 2004.
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Long-term Goal 1: Restore and enhance recreational uses

- ***Objective: Reduce bacterial loading***
    - Develop manure management plans and comprehensive nutrient management plans (part of Generally Accepted Agricultural Management Practices [GAAMPs]) (No. 1)
    - Control sanitary sewer overflows (SSOs) and maintain sanitary sewer system (No. 2)
    - Eliminate failing onsite sewage disposal systems (OSDSs) (No. 3)
    - Manage lagoon systems and package wastewater treatment plants (WWTP) (No. 4)
    - Manage pet waste and wildlife populations (No. 5)
- ***Objective: Reduce nutrient loading***
    - Support environmentally friendly lawn and garden maintenance (No. 6)
    - Install buffers and protect riparian corridor (No. 8)
- ***Objective: Provide additional public access to water resources***
    - Identify riparian land areas for recreation enhancement and conserve for future parks and public access (No. 7)

Long-term Goal 2: Restore and protect aquatic life, wildlife, and habitat

- ***Objective: Protect and re-establish riparian and instream habitat***
    - Install buffers and protect riparian corridors (No. 8)
    - Install storm drain markers (No. 9)
    - Utilize habitat restoration techniques (No. 10)
    - Install/maintain oil and grease trap devices (No. 11)
    - Minimize the effects of salt and deicing chemical storage areas (No. 12)
- ***Objective: Reduce soil erosion and sedimentation***
    - Improve soil erosion and sedimentation control (SESC) programs (No. 13)
    - Implement streambank stabilization measures (No. 14)
    - Perform street sweeping (No. 15)
- ***Objective: Reduce excess runoff***
    - Support environmentally friendly lawn and garden maintenance (No. 7)

- ***Objective: Protect open space and natural areas within the Watershed***

    - Conduct natural feature inventory and assessments (No. 16)
    - Increase wetland conservation (No. 17)
    - Implement natural features and floodplain protection ordinances (No. 18)
    - Continue and expand litter and debris cleanup and recycling programs (No. 19)
    - Continue and expand household hazardous materials management programs (No. 20)

Long-term Goal 3: Protect public health

- ***Objective: Protect drinking water supply***

    - Include drinking water protection measures in Master Plans, Zoning Ordinances, and Source Water Protection Plans for the Cities of Algonac and New Baltimore and Ira Township (No. 21)

- ***Objective: Reduce pollutants resulting in fish advisories***

    - Continue and expand household hazardous materials management programs (No. 20)
    - Identify and eliminate illicit discharges (No. 22)

- ***Objective: Reduce bacterial loading***

    - Develop manure management plans and comprehensive nutrient management plans (part of [GAAMPs]) (No. 1)
    - Control SSOs and maintain sanitary sewer system (No. 2)
    - Eliminate failing OSDSs (No. 3)
    - Manage lagoon systems and package WWTP (No. 4)
    - Manage pet waste and wildlife populations (No. 5)

Long-term Goal 4: Reduce impacts from peak flows

- ***Objective: Establish target peak flows for tributaries***

    - Conduct hydrologic analysis (No. 23)

- ***Objective: Develop water resource protection and management ordinances to reduce runoff***

    - Implement storm water ordinance that includes Low Impact Development (LID) practices (No. 24)

- ***Objective: Reduce storm water runoff quantity and minimize post-storm instream velocities***

    - Construct and maintain storm water storage facilities (No. 25)
    - Install and maintain storm sewer infiltration devices (No. 26)
    - Enhance storm water treatment (No. 27)
    - Prevent and remove flow obstructions following woody debris management techniques (No. 28)

4.1 ESTIMATED POLLUTION REDUCTIONS FROM PROPOSED ACTIONS AND BMPS

The estimated pollution reductions for sediment and nutrient have been determined using the best available information from the Watershed and the most recent tools developed for calculating these reductions. The reductions are estimated for agricultural cropland sources, urban runoff sources, and all other nonpoint source (NPS) sites that were previously described in Chapter 1. The actions and BMPs selected by the Anchor Bay Steering Committee (Steering Committee) to address those sources and sites were determined to be the most feasible and cost effective for this Watershed.

4.1.1 SEDIMENT AND NUTRIENT LOADINGS AND REDUCTIONS FROM AGRICULTURAL AREAS

The actions and systems of BMPs that have been identified to be implemented in the Watershed to achieve the estimated reductions were determined from the information collected during the Watershed inventory and previous studies. Certain assumptions were made about the agricultural areas to use the Michigan State University's "*Revised Universal Soil Loss Education (RUSLE) Online Soil Erosion Assessment Tool"* and the Michigan Department of Environmental Quality (MDEQ) "*Pollutants Controlled and Documentation for Section 319 Watershed Training Manual"* to estimate the sediment and nutrient loadings and reductions.

All of the calculations were computed for the subwatersheds delineated for the Build Out Analysis (FTC&H, 2005). The following assumptions for the agricultural areas were used:

- The contributing area of the agricultural land was estimated within each subwatershed using Geographic Information System (GIS) land use data and topographical maps.

- Soil types within each subwatershed were evaluated separately and the results were weighted to obtain a single soil loss value for each subwatershed.

- The major soil types of those agricultural areas were categorized using the United States Department of Agriculture (USDA) Soil Surveys of Macomb and St. Clair Counties. Each soil type has an associated range of slopes. The median of each range was used for each soil type.

- The existing (before treatment) crop rotation and tillage conditions were determined from information provided by the USDA Natural Resources Conservation Service (NRCS) District Conservationist and the local knowledge from the Technical Subcommittee.

- The practices implemented (after treatment) of crop rotations and tillage conditions were assumed based on the soil types and rotations, and the conservation tillage practices recommended.

- A weighted average, based on the areas of conservation tillage and filter strips, was used to determine the soil loss after treatment.

The complete methodologies and assumptions are described in Appendix 1E. Calculations at the subwatershed level enabled the evaluation of the specific recommendations in this WMP and prioritization of the remediation efforts on a subwatershed level.

Table 4-3 provides a summary of the calculations of the estimates of sediment and nutrient loadings and reductions in the subwatersheds. The numbers themselves do not necessarily present a completely accurate amount of the sediment and nutrients delivered to the stream, but rather can be used to prioritize the subwatersheds by their relative loadings to Anchor Bay, since the methodologies and assumptions were consistently applied to all subwatersheds.

TABLE 4-3: SEDIMENT AND NUTRIENT LOADINGS AND REDUCTIONS FROM AGRICULTURAL AREAS

Sub District	Total Soil Loss Before Treatment (tons/yr)	Total Soil Loss After Treatment (tons/yr)	Total Sediment Reduction (tons/yr)	Before Phosphorus Content (lbs/yr)	Before Nitrogen Content (lbs/yr)	After Phosphorus Content (lbs/yr)	After Nitrogen Content (lbs/yr)	Total Phosphorus Reduction (lbs/yr)	Total Nitrogen Reduction (lbs/yr)
Islands	584	91	247	534	1,069	116	232	418	837
St. Clair River Drainage	276	43	116	350	700	78	156	272	544
Marine City Drainage	598	93	253	624	1,248	140	279	484	968
Swartout Creek	42	7	18	45	90	10	20	35	71
Beaubien Creek	1,557	219	742	1,596	3,191	329	658	1,266	2,533
Fair Haven Drainage	579	90	244	634	1,269	147	294	487	975
Swan Creek	4,096	582	1,934	4,455	8,909	950	1,900	3,505	7,009
Marsac Creek	994	152	429	1,088	2,176	248	497	840	1,679
Crapau Creek	343	53	146	376	752	87	173	289	579
Goulette Point Drainage	3	0	1	3	6	1	1	2	4
Salt River	4,301	559	2,224	5,242	10,483	995	1,989	4,247	8,494
Anchor Bay Harbor	0	0	0	0	1	0	0	0	1
Pitts Drain	237	37	101	257	513	58	117	198	396
Anchor Bay Shores	27	4	11	29	59	7	13	23	45
Total	13,638	1,931	6,467	15,233	30,465	3,165	6,330	12,068	24,135

Notes:

- This table summarizes the overall or "total" sediment and nutrient reductions.
- Total soil loss before treatment = existing soil loss (sediment loading), before any BMPs have been implemented.
- Total soil loss after treatment = soil loss (sediment loading), after BMPs have been implemented.
- Total sediment reduction = reduction in sediment loading as a result of BMP implementation. Delivery ratio was factored into agricultural fields portion of total sediment reduction.
- Before phosphorus content = existing phosphorus loading, before any BMPs have been implemented.
- Before nitrogen content = existing nitrogen loading, before any BMPs have been implemented.
- After phosphorus content = phosphorus loading, after BMPs have been implemented.
- After nitrogen content = nitrogen loading, after BMPs have been implemented.
- Total phosphorus reduction = reduction in phosphorus loading as a result of BMP implementation.
- Total nitrogen reduction = reduction in nitrogen loading as a result of BMP implementation.

Overall, the numbers suggest that in the agricultural areas, if all recommended practices were implemented at all identified sites, 48% of the sediment delivered from those sites would be reduced, as well as 80% of the nitrogen and 80% of the phosphorus.

Pollutant reductions for phosphorus and nitrogen are based on the amount of sediment delivered, thus the calculations are dependent on the accuracy of the data collected at the site pertaining to soil loss. These estimates are based on limited field measurements, due to time and financial constraints. The results, therefore, are purely estimates of the pollutant removal capability of the actions and BMPs implemented. Detailed site specific measurements and calculations, at the time of implementation, will yield more accurate numbers.

4.1.2 SEDIMENT AND NUTRIENT LOADINGS AND REDUCTIONS FROM URBAN AREAS

A Pollutant Load Reduction Model was developed by the Illinois Department of Environmental Management Watershed Management Section, based on the MDEQ's "*Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual,"* and further modified by incorporating the Illinois Environmental Protection Agency's (IEPA) calculations for urban settings. This model was adopted by the U.S. Environmental Protection Agency's (EPA) Region 5 office for all states to use and is based on very simple and sound principles. The model does not estimate the load reduction for dissolved pollutants, and was used only to estimate loadings and reductions for selective individual BMPs.

The methodology for the gross estimate of sediment and other constituent load reductions from the implementation of urban BMPs is based on reduction efficiencies and calculations developed by IEPA. The model uses many simplifying assumptions to provide a general estimate of pollutant load reductions through BMP implementation. The land use data was extracted using GIS information. The acreage of areas with storm sewers within each subwatershed's land use was determined through conversations with the drain commissioners and local officials. This model does not estimate pollutant load reductions for dissolved constituents. Multiple practices, determined by the Technical Subcommittee, were considered for each subwatershed and the results were tabulated for all scenarios. The estimated reductions for each practice for each subwatershed can be compared for applicability to that particular subwatershed. More accurate results of pollutant load reductions could be obtained through direct monitoring and/or a more detailed modeling application. A summary of the agricultural and urban pollutants reduced is presented in Table 4-4.

The reductions achieved from the various BMPs selected for analysis, presented in Table 4-5, ranged from 16% to 89% reduction of sediment, with an average reduction of 57%. For nitrogen, the range was from 5% to 57%, with an average of 26%. For phosphorus, the range was from 5% to 67%, with an average of 31%.

TABLE 4-4: ANCHOR BAY WATERSHED POLLUTANT LOADINGS AND REDUCTIONS

Subwatershed	Loading			Reduction				
Islands	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other - Oil/Grit Separator
Total Suspended Solids (tons/yr)	584	337		247	219	240	161	42
Total Nitrogen (lbs/yr)	1,069	10,210		837	1,021	4,870	2,657	443
Total Phosphorus (lbs/yr)	534	1,141		418	285	676	257	49
Acres	**1,255**	**11,571**	**11%**					
St. Clair River drainage	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	276	132		247	86	108	72	19
Total Nitrogen (lbs/yr)	700	4,291		837	429	2,204	1,202	200
Total Phosphorus (lbs/yr)	350	444		418	111	282	107	21
Acres	**677**	**1,851**	**37%**					
Marine City drainage	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	598	370		253	240	311	208	54
Total Nitrogen (lbs/yr)	1,248	12,061		968	1,206	6,469	3,529	588
Total Phosphorus (lbs/yr)	624	1,205		484	301	803	305	59
Acres	**2,421**	**7,031**	**34%**					

TABLE 4-4: ANCHOR BAY WATERSHED POLLUTANT LOADINGS AND REDUCTIONS

Subwatershed	Loading			Reduction				
Swartout Creek	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	42	503		18	327	279	186	49
Total Nitrogen (lbs/yr)	90	16,795		71	1,679	5,569	3,038	506
Total Phosphorus (lbs/yr)	45	1,975		35	494	767	291	56
Acres	**193**	**8,389**	**2%**					
Beaubien Creek	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	1,557	704		742	458	616	412	107
Total Nitrogen (lbs/yr)	3,191	21,626		2,533	2,163	11,935	6,510	1,085
Total Phosphorus (lbs/yr)	1,596	2,075		1,266	519	1,427	542	104
Acres	**5,710**	**11,734**	**49%**					
Palms Road Drain	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	579	30		244	19	131	87	23
Total Nitrogen (lbs/yr)	1,269	965		975	97	2,567	1,400	233
Total Phosphorus (lbs/yr)	634	119		487	30	315	120	23
Acres	**1,423**	**1,613**	**88%**					

TABLE 4-4: ANCHOR BAY WATERSHED POLLUTANT LOADINGS AND REDUCTIONS

Subwatershed	Loading			Reduction				
Swan Creek	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	4,096	540		1,934	351	1,100	735	192
Total Nitrogen (lbs/yr)	8,909	13,291		7,009	1,329	19,725	10,759	1,793
Total Phosphorus (lbs/yr)	4,455	1,716		3,505	429	2,414	916	176
Acres	**9,198**	**19,039**	**48%**					
Marsac Creek	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	994	233		429	152	352	235	61
Total Nitrogen (lbs/yr)	2,176	6,668		1,679	667	6,580	3,589	598
Total Phosphorus (lbs/yr)	1,088	806		840	201	838	318	61
Acres	**2,404**	**6,237**	**39%**					
Crapau Creek	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	343	427		146	277	366	245	64
Total Nitrogen (lbs/yr)	752	10,968		579	1,097	5,881	3,208	535
Total Phosphorus (lbs/yr)	376	1,263		289	316	831	315	61
Acres	**837**	**4,567**	**18%**					

TABLE 4-4: ANCHOR BAY WATERSHED POLLUTANT LOADINGS AND REDUCTIONS

Subwatershed	Loading			Reduction				
Goulette Point drainage	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	3	118		1	77	123	82	22
Total Nitrogen (lbs/yr)	6	3,371		4	337	2,367	1,291	215
Total Phosphorus (lbs/yr)	3	424		2	106	295	112	22
Acres	**6**	**891**	**1%**					
Salt River	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	4,301	1,741		2,224	1,132	1,261	843	220
Total Nitrogen (lbs/yr)	10,483	47,389		8,494	4,739	20,903	11,402	1,900
Total Phosphorus (lbs/yr)	5,242	5,422		4,247	1,356	2,964	1,125	216
Acres	**7,803**	**23,069**	**34%**					
Anchor Bay Harbor drainage	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	0	36		0	23	27	18	5
Total Nitrogen (lbs/yr)	1	1,013		1	101	528	288	48
Total Phosphorus (lbs/yr)	0	130		0	32	85	32	6
Acres	**1**	**394**	**0%**					

TABLE 4-4: ANCHOR BAY WATERSHED POLLUTANT LOADINGS AND REDUCTIONS

Subwatershed	Loading			Reduction				
Pitts Drain	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	237	1,071		101	696	814	544	142
Total Nitrogen (lbs/yr)	513	26,078		396	2,608	12,464	6,799	1,133
Total Phosphorus (lbs/yr)	257	2,797		198	699	1,651	627	121
Acres	**546**	**4,837**	**11%**					
Anchor Bay Shores drainage	Agricultural land	Other areas	% Ag. land	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	27	1,481		11	963	1,151	769	201
Total Nitrogen (lbs/yr)	59	29,180		45	2,918	13,792	7,523	1,254
Total Phosphorus (lbs/yr)	29	3,313		23	828	1,986	754	145
Acres	**63**	**4,724**	**1%**					
Totals	Agricultural land	Other areas	Total Loadings	Ag. BMPs with Filter strips	Other - Grass Swale	Other - Ext. Wet Detention	Other - Dry Detention	Other Oil/Grit Separator
Total Suspended Solids (tons/yr)	13,637	7,723	21,360	6,597	5,020	6,879	4,597	1,201
Total Nitrogen (lbs/yr)	30,466	203,906	234,372	24,428	20,391	115,854	63,195	10,531
Total Phosphorus (lbs/yr)	15,233	22,830	38,063	12,212	5,707	15,334	5,821	1,120
Acres	**32,537**	**105,947**	**31%**					

TABLE 4-5: POLLUTANT REDUCTIONS ACHIEVED

	Percent Reduced in Agricultural Areas	Average Reduction in Urban Areas	Percent Average Reduction in Urban Areas	Highest Percent Reduction in Urban Areas	Lowest Percent Reduction in Urban Areas
Sediment (tons/yr)	48%	4,424	57%	89%	16%
Nitrogen (lbs/yr)	80%	52,493	26%	57%	5%
Phosphorus (lbs/yr)	80%	6,996	31%	67%	5%

Many combinations of actions and BMPs can be implemented to realize pollutant reduction goals. The most effective combination will be the one that is most feasible for the stakeholders based on cost, acceptability, and sustainability. Local and national efforts are continuing to identify pollutant removal effectiveness of actions and BMPs and estimated pollutant reductions expected. Not all of the answers to the question of which practices will meet the pollutant reduction goals are included in the WMP. However, the best available information has been referenced to estimate pollutant reduction predictions in the interest of determining a path to appropriate pollutant reductions. Supporting information is included in Appendix 1F.

4.2 EVALUATION OF PROPOSED ACTIONS AND BMPS

The Watershed is comprised of diverse local communities, from rural townships to urban city centers. Subsequently, a variety of actions and BMPs could be considered across the Watershed. Although each action and BMP will most likely apply to at least one of the communities in the Watershed, not all of them apply to every community. Therefore, it is important to note that each action or BMP is a unique solution to a specific pollution source or problem.

The 2003 WMP provided descriptions of the BMPs, summarized in the following paragraphs. The summaries were intended to provide basic explanations of each BMP that correlate with the specific short-term objectives of the long-term goals. The list has been modified to include only those that have been selected in this 2005 WMP. Tables 4.1 and 4.2 further explain the actions and BMPS that are now recommended.

No. 1 - Develop manure management plans and comprehensive nutrient management plans (part of GAAMPs)

Recommended actions and BMPs:

- Cattle exclusion
- Agricultural waste storage facilities
- Crop residue management
- Nutrient management

In rural areas, smaller agricultural establishments and small horse farms may contribute to higher bacteria concentrations if manure is not managed properly. State agencies have the authority to manage agricultural practices through voluntary measures called GAAMPs. GAAMPs provides agricultural landowners with guidelines to follow in regard to nutrient and pesticide application and storage, manure management, groundwater protection, and a host of other agricultural BMPs to protect surface and groundwater as well as habitat. Established outreach programs are available to educate landowners about these recommended practices, which should be utilized as much as possible to control potential pollutants from this land use. The Steering Committee should work closely with the NRCS and the conservation districts to identify and promote the use of GAAMPs in problem areas.

No. 2 - Control SSOs and maintain sanitary sewer system

Recommended actions and BMPs:

- Disconnecting direct storm water discharges to the sanitary sewer by removing downspouts or rerouting storm drain and catch basin connections to the storm sewer
- Repairing or replacing defective manhole structures
- Repairing or replacing damaged sanitary sewer lines
- Constructing new sanitary or storm sewers to carry the excess flow

Sanitary sewers designed and constructed under current standards limit the amount of storm water that can enter the system. Older systems, however, have a number of ways in which excess storm water can enter the sewage collection systems. When this storm water within a sanitary sewer collection system becomes excessive, basements will flood (with sewage) unless the excess flow is discharged to the surface waters. These sewage discharges are known as SSOs. These discharges are illegal under present state and federal rules and regulations. No SSOs have been found in Anchor Bay, but caution should be taken to ensure that systems are maintained.

The potential solutions to eliminate untreated SSOs are complex due to the nature of the causes and the inter-relationships of the local and regional sewerage systems that serve the communities. The solutions can be very expensive and may take time to implement. The first step is to determine where the excess flow is entering the sewer system by smoke testing, flow measurement, television inspection of the sewer lines, or physical observation of manhole structures on the system.

No. 3 - Eliminate failing OSDSs

Identifying failed OSDS systems can be accomplished through regular inspections of the disposal system or by sampling the waterways. Inspections can occur during property transactions (a time-of-sale ordinance), during septic tank pump outs, or at specific periodic intervals. Surface water sampling to detect failing systems is often unreliable because the small volume of untreated sewage created by failing systems in comparison to total river flow may make it difficult to detect in surface waters. Once sewage is detected, sampling a source outfall or dye testing the suspect facility can identify the system that is failing.

Once a failing OSDS is identified, environmental health codes are in place at the St. Clair County Health Department and the Macomb County Health Department that ensure correction of failed systems. Depending on local ordinances and sanitary sewer availability, some homeowners may be allowed to repair their failing systems, while others may be required to connect to the municipal sewer system. Any onsite corrections need to be done under permit from the county health department and in conformance with their requirements. Either of these efforts can be very costly, because the Watershed's soils often require elevated and expensive new OSDSs and sanitary sewers are not available in many rural parts of the Watershed.

Septic tank maintenance measures can be used to prevent, detect, and control spills, leaks, overflows, and seepage from occurring in the sanitary system. Onsite sewage disposal systems should be designed, sited, operated, and maintained properly to prevent nutrient and pathogen loadings to surface waters and to reduce loadings to groundwater. Septic tanks should be pumped at least every 3 to 5 years, depending on the size of the family or group using the tank.

No. 4 - Manage lagoon systems and package WWTP

Lagoon systems and package WWTP have been used to provide wastewater treatment in many areas of the Watershed. The most suitable use of these systems is in areas where failures have already occurred or where no other viable alternatives are available. From a planning perspective, these systems should not be used to gain additional land development density from that which is planned by the local unit of government.

When operated correctly, lagoon systems and package WWTP can provide adequate protection to the waterways. However, over an extended period of time, these systems are often poorly maintained and operated, resulting in deteriorated discharge quality. Because state regulatory agencies may not be able to provide adequate oversight on an ongoing basis due to funding and personnel constraints, local units of government should establish a mechanism for providing review of the operations, maintenance, and discharge quality of these systems (i.e. special assessment district). When violations of discharge standards are identified, existing enforcement programs should be utilized. Because of these potentially long-term problems and lack of state oversight, local communities should be consulted during the state's permitting process for lagoons and package treatment plants. As the local community is increasingly being forced to oversee many of these facilities, they should be involved in decisions that place these facilities in their municipality.

No. 5 - Manage pet waste and wildlife populations

Recommended actions and BMPs:

- Structural controls can be fences that keep grazing animals out of streams, buffer strips along grazing areas, and lagoons to control and treat manure-contaminated runoff from agricultural operations.

- Non-structural controls can be ordinances that limit the number of animals that can be housed in a given area, require specific management measures by animal owners to keep runoff away from animal waste products, or require manure management plans.

- Non-structural controls can also consist of educational initiatives, such as signs at public beaches and parks that encourage people to pick up pet waste and discourage feeding birds.

While *E. coli* is an indicator of human sewage in surface water, it also signals the presence of waste from other warm-blooded animals, which, like human sewage, can also cause disease. Therefore, animal waste should be kept from the surface waters, especially where people might be swimming.

Municipalities and counties can work with the local conservation district to encourage government agencies, civic leaders, and the agricultural community to implement source controls. Source controls can be either structural or non-structural.

No. 6 - Support environmentally friendly lawn and garden maintenance

Recommended actions and BMPs:

- Proper selection of vegetation and native plants that require minimal watering or nutrient and pesticide applications

- Incorporating integrated pest management techniques and proper watering techniques to reduce runoff and excess transpiration
- Proper lawn mowing techniques to reduce runoff rates and pollutant transport
- Proper organic debris disposal
- Composting facilities
- Proper pest control techniques to minimize the use of herbicides and pesticides

Nitrogen, phosphorus, potassium, and other nutrients are necessary to maintain optimum growth of most vegetation. Fertilizer management addresses the proper selection, use, application, storage, and disposal of fertilizers. Nutrients that are applied beyond what plants require will wash off the soil and runoff into lakes, streams, and wetlands, or leach into groundwater. When nutrients, such as phosphorus runoff into surface waters, they can cause algae blooms and excessive aquatic plant growth. Practicing proper fertilizer management will minimize the potential for pollution of surface and ground waters. Municipalities and the counties should implement these practices on publicly owned properties and encourage landowners to implement these practices on privately owned land. Proper lawn and garden maintenance involves a combination of mechanical methods and careful chemical application. Mechanical methods include:

Particular maintenance techniques are required on steep slopes, in or around drainage channels, streams and detention basins, and adjacent to catch basins. This BMP could be carried out though public education efforts on NPS pollution and/or through regulations requiring licensing for landscaping and lawn care professionals.

No. 7 - Identify riparian land areas for recreation enhancement and conserve for future parks and public access

In order to encourage public awareness and concern for rivers, streams, and wetlands, it is important to increase opportunities for people to access these water resources. These areas provide aesthetics and accessibility by use of amenities, such as a fishing pier, a trail system, or other recreational opportunities. The public will be able to experience the human benefits that water offers and, in turn, can work to protect the resource. Local policies and zoning can identify natural feature areas that are desired for long-term preservation or restoration.

Waterside property is typically in high demand and can be costly. It is often in the interest of local agencies and land conservancies to compete in the open market for riparian lands. This does not diminish the need for these agencies at all levels to continue to identify and obtain the rights to conserve riparian lands. Once the available property has been identified, funding must be secured through general funds, state programs, federal programs, and/or foundations. The acquisition of these areas can be identified by local units of government through the use of natural area inventories. In turn, riparian areas can be included in long-term land use plans and can be included in local policy decisions. The properties, once secured, can provide both recreational opportunities and environmental benefit in the riparian areas.

No. 8 - Install buffers and protect riparian corridors

Recommended actions and BMPs:

- Vegetative buffers or filter strips
- Forested or wooded riparian buffers

Sheet or overland runoff can carry large amounts of contaminants into streams and directly into the bay during wet weather events. Proper maintenance of areas adjacent to riparian corridors that are left in their natural state or are established as buffer strips, provide an excellent filtering mechanism that removes suspended materials contained in the runoff. At a minimum, buffer strips should be twenty feet wide and contain native plant materials in order to provide sufficient filtering. Filter strips are generally located adjacent to agricultural operations to reduce contamination by manure, sediment, and chemicals used for crop production. These strips can also be very effective in urban settings and can be utilized in areas that contribute to storm sewer systems, as well as in direct overland runoff locations. Local units of government can provide land planning tools that will assist landowners and developers with information to properly buffer tributaries, streams, and other water features. These planning tools can utilize overlay districts, required vegetated set back areas, or natural vegetation easements to achieve proper buffering of the riparian land areas. These planning tools can, and should, be incorporated into community comprehensive plans and zoning ordinances. Funding through USDA or Farm Bill programs, grants, and other local agencies and foundations should be investigated to assist putting buffers in critical areas.

No. 9 - Install storm drain markers

Recommended actions and BMPs:

- Support storm drain marking programs

Storm drain marking programs have been implemented in many communities across the nation in an effort to preserve the quality of our water resources through public education. A permanent marker can be permanently affixed to curbs and gutters by volunteer groups or municipal public works departments. A

variety of messages can be printed on the markers, such as “No Dumping, Flows to Bay.” As part of public education efforts, markers have been designed with the Lake St. Clair sailboat logo for use on catch basins within the Anchor Bay Watershed.

No. 10 - Utilize habitat restoration techniques

Recommended actions and BMPs:

- Identify waterways ideal for instream habitat enhancement
- Establish drain standards requiring instream habitat enhancement
- Plant trees in riparian areas to provide shade for fish, in coordination with drain commissioners
- Check dams and grade control structures

Habitat restoration techniques include instream structures that may be used to correct and/or improve animal habitat deficiencies over a broad range of conditions. Examples of these techniques include channel blocks, boulder clusters, covered logs, tree cover, bank cribs, log and bank shelters, channel constrictors, cross logs, revetments, and “K-shaped” dams. The majority of these structures are to be installed with hand labor and tools. After construction, a maintenance program must be implemented to ensure long-term success of the BMP.

No. 11 - Install/maintain oil and grease trap devices

Recommended actions and BMPs:

- Install oil and grease traps in floor drains and catch basins where concentrations of oil and grease are located

Oil and grease traps remove high concentrations of petroleum products, grease, and grit by means of gravity and coalescing plates. These devices are particularly useful on industrial sites, in vehicle maintenance and washing facilities, in areas where heavy mobile equipment is used, and in restaurant kitchens and restaurant dishwashing equipment. Conventional oil and water separators have the appearance of septic tanks, but are much longer in relationship to the width. Separators for large facilities have the appearance of a municipal wastewater primary sedimentation tank. These devices should be installed at facilities where high concentrations of oils and grease may spill into floor drains or catch basins.

No. 12 - Minimize the effects of salt and deicing chemical storage areas

Recommended actions and BMPs:

- Annually assess salt and deicing chemical storage and use

The storage of salt and other deicing chemicals at public works buildings should be properly designed to minimize runoff and the potential for pollutants to enter the waterways. Regular inspections of the sites will assess the pollution risk and recommend steps to be taken to minimize that risk.

No. 13 - Improve SESC programs

Recommended actions and BMPs:

- Ensure that the county SESC ordinance addresses state requirements as well as situations unique to the county.
- Provide adequate staff to process permits, inspect sites, and respond to complaints.
- Develop and access training programs to assure that all staff are adequately trained.
- Assure that SESC programs contain adequate enforcement provisions.
- Develop educational programs for developers and contractors within their county that will explain both the control mechanisms associated with, and the environmental reasons for, SESC programs.

Although the Natural Resources and Environmental Protection Act in Michigan requires that counties and municipalities implement and enforce an SESC program, these programs can vary with respect to their effectiveness. Macomb and St. Clair Counties have both adopted an SESC ordinance. The Counties should consider the following in respect to the enforcement of those ordinances:

No. 14 - Implement streambank stabilization measures

Recommended actions and BMPs:

- Identify unstable drains, streambanks, and outlets
- Stabilize drains, streambanks, and outlets

Streambank stabilization measures succeed by either reducing the force of flowing water or increasing the resistance of the streambank to erosion. Several types of streambank stabilization methods exist, such as engineered methods, bioengineered methods, and biotechnical methods. Engineered methods include structures, such as riprap, gabions, deflectors, and revetments. Bioengineering methods use live plants that are embedded and arranged in the ground where they serve as soil reinforcement, hydraulic drains, and barriers to earth movement. Examples of bioengineering techniques include live stakes, live fascines, brush mattresses, live cribwall, and branch packing. Biotechnical methods include integrated use of plants and inert structural components to stabilize channel slopes, prevent erosion, and

provide a natural appearance. Examples of biotechnical techniques include joint plantings, vegetated gabion mattresses, vegetated cellular grids, and reinforced grass systems.

No. 15 - Perform street sweeping

Recommended actions and BMPs:

- Develop a schedule for street sweeping and create statistics on the amount of sediment removed.

When performed regularly, street sweeping can remove 50% to 90% of street pollutants, including fertilizer runoff that can potentially enter surface waters through runoff. Street sweeping can also make road surfaces less slippery during light rains, improve aesthetics by removing litter, and control some pollutants. Street sweeping equipment consists of mechanical brooms, vacuum sweepers, or a combination of both, specifically designed to remove litter, loose gravel, soil, pet waste, vehicle debris, dust, and industrial debris from road surfaces. Sweepers that include vacuum technology are preferred from an environmental standpoint.

No. 16 - Conduct natural feature inventory and assessments

Recommended actions and BMPs:

- Initiate efforts to locate and quantify unprotected unique natural features

The first step in protecting the community's natural resources is to identify what resources should be protected, where they are located, and what benefits they provide to the community. After an inventory, it is often helpful to perform an assessment of these natural features so that they can be prioritized in terms of their importance to the community and their relative need for preservation. Often, it is not feasible to protect all of the natural features in a community. However, an inventory and assessment can provide scientific rationale to support a local protection ordinance and the basis for avoiding the feature during site design and development. Community-wide inventories and assessments can also provide future opportunities to preserve greenways for wildlife as well as recreation.

No. 17 - Increase wetland conservation

Recommended actions and BMPs:

- Develop wetland preservation ordinance
- Develop strategy for wetland conservation and mitigation banking

Preservation of wetlands is essential for the health of the Watershed and many are increasingly being lost through fragmentation and clear-cutting. Many of the wetlands are not regulated but even the regulated

wetlands continue to be destroyed because of weaknesses in the law and because the MDEQ lacks resources for proper enforcement. Municipalities should implement their own wetlands ordinance and/or use programs such as Wetland Mitigation Banking or Wetland Conservation Banking, to ensure protection of wetlands.

Wetlands and wetland complexes provide natural systems that soak up storm water during wet weather events, thus allowing water to infiltrate into vegetation and soil instead of running off directly to surface waters. Many pollutants are filtered out by the plants and soil prior to reaching the groundwater. Wetlands also reduce storm water velocities, reduce peak flows, increase base flows, filter out storm water pollutants, and provide habitat for numerous wildlife species. While storm water detention basins, rain gardens, and newly-created mitigation wetlands can provide some of the water quantity and water quality benefits of wetlands, they have not yet been able to recreate the ecologically diverse habitat values of high-quality natural wetlands. Many of the remaining natural wetlands are forested wetlands, which are particularly difficult to replace. Since fully developed, natural wetlands take decades to properly form, communities and developers should retain wetlands and wetland complexes in their natural state or use them to enhance larger storm water basins rather than remove them during construction and then re-engineer them later.

Wetland preservation may be accomplished through proper enforcement of a wetlands ordinance. In 2005, Macomb County developed a model wetlands ordinance that incorporated and performed a Michigan Natural Features Inventory. The ordinance requires a wetland use permit before any activities can take place within the wetland that may have a negative effect on the wetland's natural functions. A fact sheet explaining this ordinance is included in Appendix 4B.

The Wetland Mitigation Banking Program is an MDEQ approved tool that municipal entities may also use for wetland "preservation." Wetland mitigation is the creation and/or re-engineering of wetlands to compensate for their destruction. The prevalence of wetlands in the Watershed results in very few large development sites that would not need wetland mitigation. The Wetland Mitigation Banking Program permits a municipal entity to create wetlands and sell credits to developers that need wetland mitigation.

There are varying opinions on Wetland Mitigation Banking. Many think it is a good program for wetland conservation because it consolidates small mitigation projects, that may be located outside the Watershed or county, into larger, better designed and managed units, that may be located within the same Watershed where the destruction occurred, helping to maintain the Watershed's hydrology. Wetland Mitigation Banking can also potentially help fund implementation of watershed planning activities and help municipalities acquire wetland areas that may be used for regional detention areas, expansions of floodplain, and recreation. Many think that a Wetland Mitigation Banking Program is not beneficial to wetland conservation because re-engineered wetlands rarely contain all the original functions of the original wetland and they fear the program makes wetland destruction easier.

Another MDEQ tool for wetland preservation is called Wetland Conservation Banking. In this program, a municipal entity is permitted to preserve existing wetland areas through conservation easements. Ten acres of preserved wetlands could then be sold to a developer allowing them to destroy one acre of low-quality wetlands.

No. 18 - Implement natural features and floodplain protection ordinances

Recommended actions and BMPs:

- Develop and adopt natural features and floodplain protection ordinance

In order to direct development while protecting key local natural resources, it is often necessary to implement local ordinances that clarify why protection of certain features is important and how they will be protected under the law. These local ordinances can be more protective than state or federal law and can better reflect priorities of a local community. Example ordinances could address 100-year floodplains, woodland, wetland, and natural features setback, SESC, and fertilizer application.

Macomb County has developed a model overlay district ordinance for communities to protect a specific natural feature of an area. The overlay district will not replace existing regulations, but rather supplement them with language designed to protect significant ecosystems. Other model ordinances developed by Macomb County that offer watershed protection include a natural features setback ordinance, flood prevention, a native vegetation ordinance, and a tree and woodland protection ordinance. Fact sheets explaining these ordinances are included in Appendix 4B.

No. 19 - Continue and expand litter and debris cleanup and recycling programs

Recommended actions and BMPs:

- Organize waterway cleanup efforts
- Ensure recycling availability

Stream aesthetics, water quality, and habitat are all impacted by materials dumped into and along watercourses. Litter and debris cleanup can be achieved through adopt-a-road and local stream cleanup programs. Community organizations, schools, churches, and private companies can pledge to collect debris along local, county, and state roads, and streambanks and channels. This effort is coordinated with the local, county, or state road agencies that will remove the collected debris for proper disposal.

Material recycling benefits the environment. Materials that are recycled reduce the possibility of those materials being dumped into streams, prolong the life of local landfills, and reduce the need for raw materials for new production.

No. 20 - Continue and expand household hazardous materials management programs

Recommended actions and BMPs:

- Minimize the purchase and usage of household hazardous waste (HHW) materials that exhibit characteristics such as corrosivity, ignitability, reactivity, and/or toxicity, or are listed as hazardous materials by the EPA.
- Ensure proper storage and disposal of such materials if they must be purchased and used.
- Sponsorship or promotion of HHW collection.

The average American household contains 3 to 10 gallons of hazardous chemicals, including items such as automotive wastes, cleaners, and paints. In general, the public is unaware of the problems associated with overuse and improper disposal of these materials. In addition, the public generally does not recognize the toxicity of materials used in and around homes.

The proper disposal of hazardous materials will minimize the amount of hazardous materials that will enter surface waters and groundwater supplies.

No. 21 - Include drinking water protection measures in master plans for the Cities of Algonac and New Baltimore and Ira Township

Recommended actions and BMPs:

- Implementation of Source Water Protection Plan recommendations

A Source Water Protection Assessment has been completed for the Cities of Algonac and New Baltimore as a first step to developing a Source Water Protection Plan (Protection Plan). Ira Township has completed a Protection Plan, which outlines the steps that should be taken to ensure the quality of the drinking water. MDEQ has tentatively approved the Protection Plan, and Ira Township is responsible for implementing the recommendations in that plan to protect the drinking water supplies. Communities will eventually adopt ordinances to support the master plans that institutionalize the recommended actions.

No. 22 - Identify and eliminate illicit discharges

Recommended actions and BMPs:

- Prevention, detection, and removal of all physical connections to the storm water drainage system that convey any material other than storm water

- Implementation of measures to detect, correct, and enforce against illegal dumping of materials into storm drains, streams, and lakes

- Implementation of spill prevention, containment, cleanup, and disposal techniques at commercial, industrial, and municipal facilities to prevent or reduce the discharge of spilled materials into storm water

- Maintain or promote county Illicit Discharge Reporting Hotline

Crews of municipal workers have been trained on how to identify illicit discharges and locate illicit connections. Although this effort can be labor intensive, the reduction in the amount of sanitary sewage and chemicals that enter surface waters through elimination of these sources often has significant environmental benefits.

No. 23 - Conduct hydrologic analysis

Recommended actions and BMPs:

- Implement 2005 Hydrologic Analysis recommendations

A hydrologic model was developed by Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H), in 2005, to assess the hydrologic conditions in the Watershed and to determine peak flows associated with water quality impairments. The results recommend practices and management strategies to be adopted in the Watershed to reduce peak flows and address the high-flow issues. The hydrologic model will be an effective tool for communities to use to demonstrate their compliance with the portion of the permit that requires post-construction controls to protect receiving waters from the effects of urbanization.

No. 24 - Implement storm water ordinance that includes LID practices

Recommended actions and BMPs:

- Implementation of storm water ordinance that includes LID practices

In undeveloped areas, or in areas where redevelopment may occur, it is important to have regulations in place that can guide land development with regard to protecting the water quality, water quantity, and biological integrity of the receiving surface water. This regulation can use existing data to determine the development impact that can be tolerated by the surface waters before that system will become degraded. Future development or redevelopment can be guided to control runoff so that local streams and water resources are not negatively affected by the development to the greatest extent practical. Both the counties and communities can protect storm water and water resources through the development and implementation of ordinances.

Macomb County has developed a model storm water ordinance to encourage the use of structural, vegetative, or managerial practices designed to treat, prevent, or reduce degradation of water quality due to storm water impacts. Development projects under the ordinance should be designed, constructed, and maintained using practices to prevent flooding, protect water quality, reduce soil erosion, maintain and improve wildlife habitat, and contribute to the aesthetic value of the project. A fact sheet explaining this ordinance is included in Appendix 4B.

FTC&H developed a model storm water ordinance for the Watershed that recommends design specifications based on the criteria of flood control, stream protection, water quality protection, groundwater recharge, and LID. Standards design specifications were established for the Watershed, as well as specifications for alternative areas where unique conditions exist and coastal zones that directly discharge to Anchor Bay and the St. Clair River. A fact sheet explaining this ordinance is also included in Appendix 4C.

No. 25 - Construct and maintain storm water storage facilities

Recommended actions and BMPs:

- Wet and dry detention requirements
- Reuse of water from wet detention
- Long-term maintenance tool for clean out of basins
- Parking lot storage for storm water

Storm water storage facilities are source-control devices designed to manage flow sufficiently in order to prevent downstream flooding and/or reduce erosive velocities in the receiving stream. They can either be retrofitted into existing systems or designed into new systems. Retrofitting storage into existing drainage systems is usually very expensive. Improperly sized and sited storage facilities can also cause localized parking lot and street flooding, icing in winter months, and increased downstream flooding. Local and county drain ordinances can require development standards for construction of storm water storage facilities.

Wet detention ponds are small man-made lakes that can include emergent wetland vegetation around the banks, as well as within the pond area, and are designed to capture and remove particulate and certain dissolved constituents. Wet ponds are ideal for large, regional tributary areas (10 to 300 acres) where there is a need to achieve high levels of particulate and some dissolved nutrient removal, although they can also be used effectively in smaller size drainage areas. The outlet should be sized to assure retention of an adequate amount of water to support good vegetative growth while still reducing peak discharges to the receiving stream.

Dry detention ponds are designed to capture runoff and release it slowly to allow most of the pollutant-laden sediments to settle. This type of detention pond is designed to be dry between storm events and is primarily used for tributary watersheds ten acres and larger, although they can be effective in smaller drainage areas also. Since the purpose of a dry detention pond is to attenuate peak flow, the outlet is usually sized to draw down the first 50% of volume in 12 to 16 hours and the remaining water in 24 to 32 hours.

Both of these detention devices can be used to treat runoff, accumulate sediments, attenuate flow, and route floodwaters. Water from these devices could be used in sprinkler systems for green belts and commons areas in residential and commercial developments. This would provide relief for potable water systems during peak seasonal demands. The decision to use a dry or a wet detention basin is usually dictated by the location and other surrounding land uses. Either system will provide quality management and some degree of quality enhancement if properly designed, operated, and maintained. In all cases, the pond should be configured for aesthetics, safety, and maintenance.

Other possible detention devices are storage tanks connected to the existing drainage system, street storage, and parking lot storage. Storage tanks are often located underground. This category would include off-line storage and oversized collection pipes. Street and/or parking lot storage is usually accomplished through the use of restricted catch basins or undersized collection pipes that do not allow the maximum design flow from a storm event to be transported through the system as fast as it accumulates. Water that cannot enter the system backs up into the streets and/or parking lots.

Care needs to be taken in utilizing this BMP that the temporary flooding will not cause property damage and that icing that may form in winter months will not create a safety hazard.

To be continually effective, structural BMPs that are installed to eliminate or control storm water contamination must operate at their original design parameters. This can only be achieved if the controls are routinely checked and maintained to assure they are operating as designed. For example, sediment and oil accumulations must be regularly removed from detention ponds to maintain the design retention time at the expected storm water volume. This maintenance requirement needs to be built into the ongoing operational budget for storm water programs.

Macomb County has developed a model flood prevention district and an ordinance to enforce special regulations for the use of the land which may be subject to inundation by floods and floodwaters at predicable intervals. Floodplains are an integral part of a community and include numerous benefits, such as storing flood waters, improving water quality, stabilizing soils, offering unique habitats, and providing open space and greenways.

No. 26 - Install and maintain storm sewer infiltration devices

Recommended actions and BMPs:

- Infiltration trench
- Rain gardens
- Porous pavement

Infiltration devices in the Watershed are generally not a useful BMP because of the Watershed's predominately clay soils. However, under-drained bioretention areas and rain gardens, planted with prairie type plants, can provide an infiltration mechanism for storm water on a site-specific basis that will potentially eliminate runoff from small storms and reduce the quantity of runoff in larger storms.

No. 27 - Enhance storm water treatment

Recommended actions and BMPs:

- Catch basin clearing
- Catch basin inlet devices
- Hydrodynamic separator units

When performed on a regular basis, catch basin cleaning removes pollutants from the storm drainage system, reduces the concentration of pollutants during the first flush of storms, prevents clogging of downstream systems, restores the catch basins sediment trapping ability, and allows the in-system storage capacity of the sewers to be fully utilized. Catch basin cleaning requires the use of a vactor truck, and sumps should be cleaned before they become 40% full. Materials removed from the catch basins should be properly disposed of and not allowed to re-enter the storm sewer system. Pollutant capture within a catch basin can be improved through the use of catch basin insert devices. Depending on the type, these devices can be used to improve sediment capture and provide oil and chemical removal.

No. 28 - Prevent and remove flow obstructions

Recommended actions and BMPs:

- Obstruction removal following woody debris management techniques

Prevention and removal of stream flow obstructions involves the detection of stream blockages caused by debris, sediment, and branches or trees that have fallen into the river. If cleanup is required, it is important to do so in an environmentally friendly manner that minimizes habitat disruptions. Stream cleanup should be considered in lieu of clearing, snagging, channelization, or other severe modifications. Communities and individuals are encouraged to get involved with removing smaller obstructions before they become a major problem. This may include monitoring and maintaining stream flow conditions and checking for obstructions that are hindering the flow of the river and causing upstream ponding problems.

CHAPTER 5 - SUBWATERSHED AND COMMUNITY ACTION PLANS

5.0 INTRODUCTION

Interviews were conducted during the 2003 project to gather information from governmental units about what Best Management Practices (BMPs) were currently being implemented and where gaps could be identified in watershed protection measures. The 2003 Watershed Management Plan (WMP) stated that although the actions and support of local citizen groups, individuals, and watershed organizations in the Anchor Bay Watershed (Watershed) are crucial to protecting and improving water quality and habitat, the goals and objectives of this WMP can only be fully accomplished through the actions of the counties and local units of government located within the Watershed. These actions are more fully explored in Section 5.2 of this chapter and Table 5.1.

During the 2005 project, inventories and studies were completed that focused on the unique characteristics of each subwatershed. The 13 subwatersheds have different water quality issues and concerns of which communities need to be aware, since various management techniques might need to be applied in the subwatersheds in which their communities lie.

5.1 SUBWATERSHED ACTION PLANS

The development of the 2005 WMP involved specific tasks to better define what actions or BMPs need to be implemented in the subwatersheds to protect Anchor Bay. The specific tasks included:

- Taking a detailed inventory of the Watershed to identify nonpoint source (NPS) sites of pollution.
- Conducting a build out analysis using percent impervious coefficients to identify areas in the Watershed that would impair water quality if developed as planned in the communities' land use plans.
- Performing a hydrologic analysis to determine the most effective detention and infiltration policies to protect the Watershed from development-induced streambank erosion.
- Developing a storm water ordinance to provide protection of the environment against pollution from storm water runoff, to provide flood control and adequate drainage, and to provide for the regulation and control of storm water runoff.

These activities were performed on a subwatershed basis, rather than by community. The following concerns and recommendations have been identified for each subwatershed.

ISLAND SUBWATERSHEDS

Communities within the subwatershed - Clay Township

NPS sites - The islands have a unique place in the Watershed with special concerns to preserve the character and ecosystem. No specific NPS sites were identified.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 2.6%, and if the island is developed according to the future land use plans, the imperviousness will increase to 6.34%, keeping the islands below the standard threshold (<10% imperviousness) for water quality impairment.

Storm water ordinance recommendations based on hydrologic analysis - The alternative and coastal zone design specifications recommended in the storm water ordinance would most likely be applied to all areas of the islands, since most of the storm water has direct drainage to Anchor Bay.

ST. CLAIR RIVER DRAINAGE SUBWATERSHED

Communities within the subwatershed - Cottrellville Township, Clay Township

NPS sites - Two sites were identified as contributing pollutants from unstable stream crossings and upland agricultural sources. One of those sites also had debris and trash.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 7.70%, and if the area is developed according to the future land use plans, the imperviousness will increase to 27.94%. This increase indicates that this area would greatly impact its water resources if practices are not implemented to reduce the imperviousness of the development. This subwatershed had the greatest increase in imperviousness, changing from the sensitive category (<10%) to the degraded category (>25%).

Storm water ordinance recommendations based on hydrologic analysis - Coastal zone design specifications recommended in the storm water ordinance would most likely be applied to all areas of this subwatershed, since most of the storm water has direct drainage to the St. Clair River.

MARINE CITY DRAIN SUBWATERSHED

Communities within the subwatershed - Cottrellville Township, Clay Township, City of Algonac

NPS sites - Debris and trash and nutrient sources were noted at one site. Streambank erosion was identified at another site.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 4.25%, and if the area is developed according to the future land use plans, the imperviousness will increase to 15.87%, indicating water quality impacts.

Storm water ordinance recommendations based on hydrologic analysis - The watershed area within the City of Algonac moves into the degraded category if fully developed without storm water controls.

SWARTOUT DRAIN SUBWATERSHED

Communities within the subwatershed - Clay Township, City of Algonac

NPS sites - Debris and trash, an unstable stream crossing, a construction site, a lack of buffers, urban runoff, and nutrient sources were all identified as contributing pollutants.

Imperviousness - The results of the build out analysis revealed that average current imperviousness is 7.55%, and if the area is developed according to the future land use plans, the average imperviousness will increase to 22.84%. This area has the third highest increase in imperviousness, with the coastal area moving into the degraded category if storm water controls are not in place.

Storm water ordinance recommendations based on hydrologic analysis - Coastal zone design specifications recommended in the storm water ordinance would most likely be applied to the areas along the shorelines, since most of the storm water has direct drainage to the North Channel.

BEAUBIEN CREEK SUBWATERSHED

Communities within the subwatershed - Cottrellville Township, China Township, Ira Township

NPS sites - Five unstable stream crossings were identified. Three sites where rill and gully erosion was contributing pollutants were identified. Debris and trash, livestock access, streambank erosion, construction site, residential runoff, lack of buffer, urban runoff, and nutrient sources were also identified.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 3.85%, and if the area is developed according to the future land use plans, the imperviousness will increase to 14.18%. The upper area of the Watershed is zoned to remain agricultural, thus not increasing the level of imperviousness.

Storm water ordinance recommendations based on hydrologic analysis - The standard design specifications recommended in the storm water ordinance would most likely be applied to all areas of the subwatershed, with some needing the alternative designs if special circumstances are encountered.

PALMS ROAD DRAIN SUBWATERSHED

Communities within the subwatershed - Ira Township

NPS sites - Urban and residential runoff was observed at two sites. Streambank erosion and lack of buffers were also identified.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 6.19%, and if the area is developed according to the future land use plans, the imperviousness will increase to 20.12%.

Storm water ordinance recommendations based on hydrologic analysis - The coastal zone design specifications recommended in the storm water ordinance would be applied to areas along the shoreline, since the outlying areas are zoned to be low intensity.

SWAN CREEK SUBWATERSHED

Communities within the subwatershed - Casco Township, China Township, Ira Township

NPS sites - Seven instances of unstable stream crossings, streambank erosion, urban runoff, and nutrient sources each were identified. Six riparian areas lacked buffers, and three areas of debris and trash were identified. Rill and gully erosion, agricultural sources, and construction sites were observed contributing pollutants at two sites. Livestock access, residential runoff, and row crop runoff were also observed.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 4.12%, and if the area is developed according to the future land use plans, the imperviousness will increase to 8.50%, displaying the smallest change of percent imperviousness.

Storm water ordinance recommendations based on hydrologic analysis - The standard design specifications recommended in the storm water ordinance would most likely be applied to all areas of the subwatershed, unless special concerns are encountered. The desire of the townships to keep this area with a rural character is reflected in the future land use plans.

MARSAC CREEK SUBWATERSHED

Communities within the subwatershed - Casco Township, Ira Township, City of New Baltimore

NPS sites - Five riparian areas were identified that lacked buffers. Four streambank erosion sites and three sites each of rill and gully erosion and residential runoff were found. Two unstable stream crossings and tile outlets were eroding. Urban runoff, nutrient sources, and debris and trash were also noted.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 8.13%, and if the area is developed according to the future land use plans, the imperviousness will increase to 14.60%.

Storm water ordinance recommendations based on hydrologic analysis - The areas in the Watershed along the shoreline and in the City of New Baltimore will experience the greatest increase of imperviousness and degradation to water quality from storm water runoff with no controls.

CRAPAU CREEK SUBWATERSHED

Communities within the subwatershed - Casco Township, Lenox Township, Ira Township, Chesterfield Township, City of New Baltimore

NPS sites - Four occurrences of rill and gully erosion were observed. Three streambank erosion and urban runoff sites were identified. Agricultural sources and residential runoff was also noted.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 11.99%, and if the area is developed according to the future land use plans, the imperviousness will increase to 26.66%. Almost the entire southern half of the subwatershed in the City of New Baltimore is predicted to move into the degraded water quality category, based on the future land use plans.

Storm water ordinance recommendations based on hydrologic analysis - Crapau Creek has alternative specifications for flood control, of detaining the 100-year runoff volume with a maximum release rate of 0.10 cfs/acre.

GOULETTE POINT DRAINAGE SUBWATERSHED

Communities within the subwatershed - Chesterfield Township, City of New Baltimore

NPS sites - Urban runoff was observed in all areas of this highly impervious subwatershed.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 22.01%, and if the area is developed according to the future land use plans, the imperviousness will increase to 34.06%. This subwatershed has the second highest level of future imperviousness, consisting of high density residential areas.

Storm water ordinance recommendations based on hydrologic analysis - The coastal zone design specifications recommended in the storm water ordinance would most likely be applied to the entire subwatershed, since most of the storm water has direct drainage to Anchor Bay.

SALT RIVER SUBWATERSHED

Communities within the subwatershed - Lenox Township, Casco Township, Chesterfield Township, City of New Baltimore

NPS sites - Fifteen streambank erosion sites and fourteen areas that lacked buffers were observed. Fourteen instances of urban runoff were identified. Twelve unstable stream crossings were surveyed. Debris and trash, rill and gully erosion, livestock access, upland agricultural sources, tile outlets, construction sites, row crop erosion, nutrient sources, and one marina was also observed to be contributing pollutants.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 9.64%, and if the area is developed according to the future land use plans, the imperviousness will increase to 22.81%. This subwatershed has the largest area in the degraded category for water quality impacts.

Storm water ordinance recommendations based on hydrologic analysis - The standard design specifications recommended in the storm water ordinance would most likely be applied to all areas of the subwatershed, with some needing the alternative designs if special circumstances are encountered.

ANCHOR HARBOR DRAINAGE SUBWATERSHED

Communities within the subwatershed - Chesterfield Township

NPS sites - Urban runoff was observed in all areas of this highly impervious subwatershed.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 19.64%, and if the area is developed according to the future land use plans, the imperviousness will increase to 33.08%. This is the smallest subwatershed, with the entire area in the degraded category, consisting of commercial and residential areas along the shoreline.

Storm water ordinance recommendations based on hydrologic analysis - The coastal zone design specifications recommended in the storm water ordinance would most likely be applied to the entire area, since most of the storm water has direct drainage to Anchor Bay.

Auvase Creek Subwatershed

Communities within the subwatershed - Chesterfield Township

NPS sites - Five areas where a lack of buffer allowed pollutants into the waterways were observed. Debris and trash, unstable stream crossings, upland agricultural sources, streambank erosion, and urban runoff were also identified.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 20.43%, and if the area is developed according to the future land use plans, the imperviousness will increase to 37.26%. This subwatershed has the highest average future imperviousness, with the whole subwatershed in the degraded category. If fully developed, which is very likely, this area would suffer from water quality degradation without sufficient storm water controls to manage the flow and volume of storm water runoff.

Storm water ordinance recommendations based on hydrologic analysis - The highly impervious subwatershed would benefit from the incorporation of low impact development (LID) techniques to reduce runoff volume and size of water quality controls.

ANCHOR BAY SHORES DRAINAGE SUBWATERSHED

Communities within the subwatershed - Chesterfield Township, Macomb Township, Harrison Township

NPS sites - Urban runoff was observed in all areas of this highly impervious subwatershed.

Imperviousness - The results of the build out analysis revealed that current imperviousness is 19.24%, and if the area is developed according to the future land use plans, the imperviousness will increase to 30.37%.

Storm water ordinance recommendations based on hydrologic analysis - Most of this subwatershed is included in the Selfridge ANG Base, which makes limiting impervious surfaces difficult.

For the 2005 WMP, Table 5-1 was adjusted to reflect the current actions and BMPs being recommended for implementation. Table 5-1 still provides a summary of the interview information and demonstrates the relationship between the actions and BMPs that each community and county is implementing and/or planning and the goals and objectives of this WMP. The following terms are used in Table 5-1, as well as in Appendix F of the original WMP, to describe the level of action or BMP implementation for each community and county within the Watershed:

Current:	The action or BMP is presently being implemented and is intended to continue.
Short Term:	The action or BMP is planned for implementation within the next 3 years.
Long Term:	The action or BMP is planned for implementation within the next 8 years.
Not Applicable:	The action or BMP does not apply to the community or county.
Blank Space:	The action or BMP is not currently being implemented and there are no plans to implement in the future.

TABLE 5-1: COMMUNITY COMMITMENTS TO IMPLEMENTING ACTIONS AND BMPS

No.	Actions and Best Management Practices	St. Clair County	City of Algonac	Casco Township	China Township	Clay Township	Cottrellville Township	Ira Township	Marine City	Macomb County	Chesterfield Township	Clinton Township	Harrison Township	Lenox Township	Macomb Township	City of Mount Clemens	City of New Baltimore	City of New Haven	City of Richmond	Richmond Township
Key: C = Current S = Short Term L = Long Term N = Not Applicable * = County Program Blank Space = Not Planned																				
1	Facilitate Generally Accepted Agricultural Management Practices (GAAMPs)	S	N						N			N	N			N	N	N	N	
2	Identify and Control Sanitary Sewer Overflows (SSOs)	N	N	N	N	*	N	N	N	N	N	N	N	N	N	C	C	C	N	N
2	Maintain Sanitary Sewer Infrastructure	C	C	N	N	C	C	*, C	C	C	C	C	C	C	C	C	C	C	C	
3	Identify and Eliminate Failing Onsite Sewage Disposal Systems (OSDSs)	C	N	*	*	*	*	*	N	C	*	S	C	*	*	C	N	*	*	*
3	Implement Septic System Maintenance Measures		N	S	S	*	S	C	N	C		*		C		N	N	*	*	C
4	Manage Lagoon Systems and Package Wastewater Treatment Plants		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
4	Utilize Comprehensive Planning for Wastewater Treatment Systems	C	N		S	C		C,S	C		C	C	C	S	C				C	C

TABLE 5-1: COMMUNITY COMMITMENTS TO IMPLEMENTING ACTIONS AND BMPS

No.	Best Management Practices	St. Clair County	Algonac	Casco Township	China Township	Clay Township	Cottrellville Township	Ira Township	Marine City	Macomb County	Chesterfield Township	Clinton Township	Harrison Township	Lenox Township	Macomb Township	Mount Clemens	New Baltimore	New Haven	Richmond	Richmond Township
Key: C = Current S = Short Term L = Long Term N = Not Applicable * = County Program Blank Space = Not Planned																				
5	Reduce Bacterial Runoff from Domestic Animals and Wildlife	S	C			C	S				C		C		L	C	C			
6	Support Environmental Friendly Lawn and Garden Maintenance		S	C	S	C	S	C		C	C	C	S		S	C	C	S		
6	Reduce Fertilizer, Pesticide, and Herbicide Usage		S	C		S	C	C		C	C	C	C	C			C	C	C	
7	Conserve Riparian Land for Future Parks and Public Access		N				C	C	C			C	C		S	C	C	C		
7	Identify Areas for Recreation Enhancement		C	C		C	C	C	C	S	C	C	C	C	S	C	C	S	C	
8	Manage Riparian Corridors	C	N	N		N			C			N	C			C	C	S	N	
10	Utilize Habitat Restoration Techniques		N			N					S	C			N	C		S	C	
11	Install/Maintain Oil and Grease Trap Devices	C		C	N	C	C	C	C	C	C	C	C	C	S	C		C		

TABLE 5-1: COMMUNITY COMMITMENTS TO IMPLEMENTING ACTIONS AND BMPS

No.	Best Management Practices	St. Clair County	Algonac	Casco Township	China Township	Clay Township	Cottrellville Township	Ira Township	Marine City	Macomb County	Chesterfield Township	Clinton Township	Harrison Township	Lenox Township	Macomb Township	Mount Clemens	New Baltimore	New Haven	Richmond	Richmond Township
	Key: C = Current S = Short Term L = Long Term N = Not Applicable * = County Program Blank Space = Not Planned																			
12	Minimize the Effects of Salt and De-icing Chemicals Storage Areas	C			N	C	C	C	C	C	C	*,S								
13	Control Soil Erosion	C	*	*	*	*	*	*	*	C	*	*	*	*	*	C	C	*	*	*
13	Implement Soil Erosion and Sedimentation Control (SESC) Programs	C	*	*	*		*	*	*	C	*	*	*	*	*	C	C	*	*	*
14	Implement Streambank Stabilization Measures	S	C	N	N	N		C	C	C,S		N		C	N	C	C	*	N	*
15	Perform Street Sweeping	C	C	N	N	N	N	N	C	C	C	C		*	C	C	C	C	C	N
16	Conduct Natural Feature Inventory and Assessments	L	N	C						C	*	L	S	*	S	*	*	C	*	*
17	Construct Wetlands	L		N							C	N								
17	Preserve and Enhance Existing Wetlands/Woodlands		N	C		C		C			C	C	C	C		C	C	C	C	
17	Support Wetland Mitigation Banking	L										C								
18	Implement Natural Features and Floodplain Protection Ordinances							C		C		L	S	C	C		C	C	C	

TABLE 5-1: COMMUNITY COMMITMENTS TO IMPLEMENTING ACTIONS AND BMPS

No.	Best Management Practices	St. Clair County	Algonac	Casco Township	China Township	Clay Township	Cottrellville Township	Ira Township	Marine City	Macomb County	Chesterfield Township	Clinton Township	Harrison Township	Lenox Township	Macomb Township	Mount Clemens	New Baltimore	New Haven	Richmond	Richmond Township
		Key: C = Current S = Short Term L = Long Term N = Not Applicable * = County Program Blank Space = Not Planned																		
18	Integrate Natural Resource Protection into the Planning Process	C	C	C		C		C		C	S	L	C	C			C	C		
19	Continue/Expand Litter and Debris Clean-up and Recycling Programs	C	C		C	C	C	C	C	C		C		S		C	C	C	C	C
20	Conduct Household Hazardous Materials Management Programs	C		*	*	C	C	*	C	C		C	*	*	*	*	C	C		C
22	Identify and Eliminate Illicit Discharges	C	*	*	*	C	*	*	C	C	*	S	S	*	S	C	C	*	*	*
22	Reduce/Eliminate Oil/Chemical Discharges	C	C	N	N	C	N			C	C	C	S	C	S			S	C	N
24	Implement Storm Water and Water Resource Protection Ordinances	L	C,S					S		C, L		S			L	S				C
25	Construct/Maintain Storm Water Storage Facilities	C		C		C		C		N	C	C	C	C,S	C	C	C	C	C	C

TABLE 5-1: COMMUNITY COMMITMENTS TO IMPLEMENTING ACTIONS AND BMPS

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Key: C = Current S = Short Term L = Long Term N = Not Applicable * = County Program Blank Space = Not Planned																				
25	Maintain Storm Water Controls		N		N	N	N	N	N	N	C	C	C	C	C	N		C		N
25	Perform Storm Sewer System Maintenance and Drain Cleaning	C	C	N	N	N	N		C	C,S		C		N	C	C	C		C	N
26	Install/Maintain Storm Sewer Infiltration Treatment Devices		C	*		C				C		S	C					C		
26	Reduce Directly Connected Impervious Surfaces		C	C		C	C	C			C	S	C	C	C			C	C	N
27	Enhance Catch Basin Functionality		C	N	N	N	N	N	C	C		C		S	C		C	C	C	N
27	Install/Maintain Sediment Control Devices	C	C	N	*	N		C			C		C	C			*	C		C
28	Prevent and Remove Flow Obstructions Following Woody Debris Management Techniques		*	*	*	N	*	*	C	C,S		N	C	C	N	C	*	*		*

5.2 COMMUNITY HIGHLIGHTS

A series of meetings were held with the counties and local communities to determine what BMPs they were currently implementing or planning to implement in the short- or long-term time frame. A BMP includes projects, planning ordinances, or practices that the community or county is, or will be, implementing to control pollution sources or causes of pollution. Members of the 2003 Anchor Bay Technical Committee (Technical Committee) met with representatives from each of the local communities, including public works directors, planning staff, supervisors, and community engineers. To the maximum extent possible, the same Technical Committee members participated in each interview to ensure uniformity in regard to presentation and information collection.

To facilitate meetings with governmental units, an interview form was developed using the BMPs discussed in Chapter 4. For the purpose of discussion, the BMPs were grouped into five categories: 1) illicit discharges, 2) soil erosion, 3) public education, 4) infrastructure, 5) habitat and planning. The goals and objectives of the plan were reviewed at these meetings prior to discussing the BMPs that were being implemented. The completed interview forms, with detailed notes, are included in Appendix F of the original WMP and should be used by the community and county as an indication of the activities that may be included in their Storm Water Pollution Prevention Initiative (SWPPI), which is required under the National Pollutant Discharge Elimination System (NPDES) Phase II Storm Water permit.

Interview results show that many of the activities required to protect and restore the Watershed are ongoing. This section highlights a number of projects that are currently taking place. Each project serves as an example of how Anchor Bay communities are currently working toward addressing water quality and/or quantity problems.

FINANCIAL SOLUTIONS

Most communities have considered how to finance projects associated with the storm water control programs, but Clinton Township is the only community that has developed an ordinance that allows for establishing storm water fees based on the impervious area in new development projects. These fees will be used to support programs required under this plan.

WATER QUALITY MONITORING

Since 1997, Macomb County has performed monitoring in the Watershed through the Lake St. Clair Assessment Program (Assessment Program). Recently, additional funding was allocated from the State of Michigan (State) to geographically expand the Assessment Program to areas in St. Clair and Oakland Counties. This project, named the Lake St. Clair, Clinton River, and St. Clair River Water Quality Monitoring Project, is a cooperative effort between Macomb, Oakland, and St. Clair Counties to evaluate impairments in the St. Clair River, Clinton River, and Lake St. Clair. The project consists of developing a three-year comprehensive monitoring effort that will include the following components:

- Continuous water quality monitoring at 14 fixed stations (one station within Anchor Bay).
- Automatic sampling during wet weather events for various parameters (one site within Anchor Bay).
- Manual grab sampling for various parameters (two sites within Anchor Bay).
- Sediment sampling in depositional zones in Lake St. Clair and inland lakes (two sites within Anchor Bay).
- Macrophyte and algae sampling in Lake St. Clair (two sites within Anchor Bay).
- Current, flow, and rainfall monitoring (one site within Anchor Bay).
- A bacterial source tracking study (site to be determined).
- Long-term toxin monitoring (site to be determined).

Other important aspects of the project include: development of a water quality database; improved understanding of water quality in the study area; identification of areas needing remedial actions; enhanced partnering between counties, municipalities, academia and others; public involvement; and publication of project data through a website. The complete work plan and project description for this project can be obtained by contacting the Macomb County Health Department.

ILLICIT DISCHARGES

Illicit discharges may contribute a significant pollutant load to Anchor Bay and its tributary streams. Control and elimination of these illicit discharges generally involves locating outfalls and eliminating contaminants at the source rather than providing end-of-pipe treatment. Both Macomb and St. Clair Counties have recently invested extensive resources to investigate and eliminate sources of human sewage throughout the Watershed. In 2002, both counties received Clean Michigan Initiative grants to conduct Illicit Discharge Elimination Programs (IDEP). Sources are being eliminated as they are identified. Problem outfalls are being referred to local communities for source investigation and correction, and businesses and residents are being asked to fix discharges from privately owned buildings and homes. Macomb County has also implemented an onsite disposal system evaluation and maintenance ordinance that requires the inspection of septic systems when a house is sold.

Locating sources of illicit discharges within enclosed storm water drainage areas can be a time-consuming and expensive process. The City of New Baltimore has been actively pursuing potential sewage sources that have been contributing to elevated *E. coli* levels in Crapau Creek for years. To date, they have spent a substantial amount of time and money to locate and eliminate several illicit connections throughout their storm water system. However, elevated levels of *E. coli* still exist in the Crapau Creek, a situation that indicates the presence of additional sources. Although this situation is not unique to an established community like the City of New Baltimore, stakeholders need to understand the complexity and expense of locating illicit connections in developed areas.

Although many of the bacteria sources within the Watershed are human, pet waste also contributes to this problem. To alleviate this problem, some Watershed communities have restricted pet access to community parks and other public property, or passed ordinances that require owners to clean up after their pets. The City of Algonac has taken a unique approach to controlling the problem by providing bag dispensers and disposal stations for pet waste cleanup (Figure 5-1).

Figure 5-1: Pet Waste Disposal Station in Algonac

SOIL EROSION

As noted in Chapter 1, soil erosion and streambank erosion result in habitat destruction and a significant sediment load to tributary streams. Most communities require that new developments obtain a soil erosion permit from the county agency and provide a copy of that permit to the community as part of their building permit approval process. However, the City of Algonac and the Village of New Haven have taken this a step further by incorporating this requirement, as well as other storm water controls, under their Engineering Standards Ordinance. China Township includes these requirements as part of the standard building permit package that they provide to residents and developers. Several of the communities, including New Baltimore, Clinton Township, and Chesterfield Township, have enabling ordinances that allow them to maintain any sedimentation basins installed within their communities. If a local developer and/or homeowners association fails to properly operate and maintain the devices, then the community will maintain the basins and assess the cost back to the developer or association.

PUBLIC EDUCATION

While many programs can be initiated by communities and counties to ensure protection of the water quality and habitat, residents within the Watershed need to be aware of how their individual actions affect water quality and what they can do to eliminate or reduce pollution sources. This is accomplished through public education-related BMPs.

In the near future, all communities within the Watershed will be providing educational materials to their residents through cable television public access channels, websites, periodic newsletters, and/or brochures that will be made available at public buildings and offices. Chesterfield Township has gone a step further by implementing a catch basin decal program to serve as a reminder to their residents that the storm sewer catch basins drain directly to the bay.

Figure 5-2: The Pollution Solutions! presentation is offered to schools in both St. Clair and Macomb Counties

Both Macomb and St. Clair Counties educate the next generation through various student programs, such as the Pollution Solutions! presentation (Figure 5-2). This is offered to all elementary and high schools in the Watershed and has proven to be a very effective program for helping students understand pollution sources and water resource issues.

A very important public outreach component has been to involve communities in the Watershed-planning efforts. Although many communities are hesitant to take on additional responsibilities due to limited budgets and staffing constraints, most of the communities within the Watershed have been active participants. In particular, Ira Township and the City of New Baltimore have recognized the importance of water resources protection and have taken the lead on the Anchor Bay Watershed Steering Committee (Steering Committee). The Ira Township Supervisor serves as the Chairman of the Steering Committee, and the Mayor of the City of New Baltimore serves as the Vice-Chair.

INFRASTRUCTURE

Proper infrastructure maintenance is essential if the installed BMPs and the sewage and storm water collection systems are to function as designed. Failure of these systems can result in sewage discharge to the streams and bay, increased sediment discharges, and excessive flows in the streams that result in downstream and localized flooding. Additionally, as development increases within the Watershed, it is important that communities limit the amount of area that can be made impervious and control the locations of development to reduce the impact on waterways to the maximum extent possible.

All communities that have sanitary sewer systems have maintenance programs to ensure that their systems operate properly. However, the City of Mount Clemens is the only community that has formalized the program to the extent of developing a Capacity, Management, Operation, and Maintenance program in accordance with U.S. Environmental Protection Agency (EPA) draft policies.

HABITAT AND PLANNING

Macomb County is currently conducting a Michigan Natural Features Inventory (MNFI) that will be available to all communities in Macomb County. The County will also conduct a program, called a "leaf-off flyover," to take digital photographs of the entire county. These tools will significantly improve the ability of the county and local communities to protect, preserve, and enhance valuable wetland and woodland areas.

Many communities have recreational master plans and have begun to review property that becomes available along stream corridors for possible purchase in order to protect the riparian zone from additional development. Clay Township, Ira Township, and the City of Algonac participated in development of a nature trail in St. Johns Marsh, which provides habitat protection and a venue for public education.

The City of Mount Clemens installed a wet weather flow retention basin along the Clinton River as part of their combined sewer overflow control program. Since the installation, the City went back and developed a habitat restoration project adjacent to the basin; that included planting native vegetation and soft engineering methods to stabilize the banks.

Land use planning for future development in the Watershed is imperative if it is going to be done in a manner that minimizes impacts on the habitat and water quality. Richmond Township has adopted an ordinance that allows for the transfer of development rights within the township to protect existing farmland. Ira Township has developed a land use master plan that reflects, and is based on, the sewer master plan for the community. These ordinances are examples of how proper planning efforts can aid with long-term protection and enhancement of the habitat and water quality within the Watershed.

COST ESTIMATES

The Watershed communities may not be familiar with the activities outlined in the gap analysis. To aid the communities, the Steering Committee will develop a table of unit costs for the effort associated with these activities. Costs will be developed using informational documents created by neighboring watersheds, and reviewed by the Technical Committee. A brief description of each activity will be provided, along with a range of hours and typical hourly rates. The purpose of this table is to give communities a rough cost estimate for implementing various projects. Costs of specific BMPs are also listed in Tables 4-1 and 4-2. Once a specific scope of work is developed for an activity, better costs should be obtained.

Additional cost information and criteria for BMPs can be found from numerous sources including:

www.cwp.org/pubs_download.htm
www.rougeriver.com/watershed
www.bmpdatabase.org
www.michigan.gov/deq
www.epa.gov.

5.3 GAP ANALYSIS

The Technical Committee evaluated community and county activities to identify gaps in the implementation phase of the WMP. A gap was identified where goals and/or objectives are stated but no or minimal community and county actions are being implemented or planned for future. The identified gaps can serve as recommendations for actions needed in order for the goals of this WMP to be accomplished.

Two of the most important gaps identified in implementing this WMP are the lack of sustainable funding for storm water programs and the lack of water quality monitoring programs.

FINANCIAL SOLUTIONS GAP ANALYSIS

In order for this WMP and Phase II NPDES Storm Water permit regulations to be implemented, communities and counties need to develop methods to fund storm water programs. Some possible funding mechanisms include state and federal grants, special assessment districts, and storm water utility fees. Communities and counties should work together to develop coordinated program funding strategies.

2005 UPDATE

The St. Clair County Health Department secured an EPA Section 319 transition grant to revise the original WMP to meet the EPA Nine Required Elements. With the completion and approval of the revised WMP, entities within the Watershed will be eligible to apply for additional 319 and CMI funding to implement recommended actions.

Water Quality Monitoring Gap Analysis

The Lake St. Clair, Clinton River, and St. Clair River Water Quality Monitoring Project has recently been developed to establish baseline conditions at select locations within the Watershed over the next three years. This project aids in characterizing water quality in the Watershed by expanding existing monitoring programs being performed by St. Clair and Macomb Counties. The communities and counties within the Watershed need to develop a mechanism to sustain and expand this project beyond its initial three years.

2005 UPDATE

ILLICIT DISCHARGE GAP ANALYSIS

Both of the Macomb and St. Clair County IDEP programs have surveyed, detected, and eliminated many illicit discharges in the Watershed. By September 2004, all other NPDES Phase II communities should have also begun implementation of a program within their community. All communities within the Watershed, whether Phase II or not, should be responsible for proactively finding and eliminating illicit discharges within their jurisdiction.

In order to maximize resources, the two counties and communities within them should have coordinated complimentary IDEP activities. Before communities submitted their IDEP plan to the Michigan Department of Environmental Quality (MDEQ) in September 2004, discussions were held regarding: consistency of IDEP data; public education regarding illicit discharge reporting; reduction of bacterial runoff from domestic animals and wildlife; and identification of agricultural problem areas and how GAAMPs can best be encouraged in those areas.

2005 UPDATE

All NPDES Phase II local communities and counties within the Watershed submitted their IDEPs to the MDEQ. Plans are still in the process of being approved.

SOIL EROSION GAP ANALYSIS

Although both counties conduct SESC for most communities, field data has demonstrated a need to improve these programs. A detailed review of SESC programs, fee schedules, enforcement, and the number of inspections per site should be analyzed for improvements needed. Soil erosion training should also be implemented among municipal field staff so they can alert county SESC inspectors of any problems they observe in the field. Documentation of municipal employee training programs will be required as part of community and county SWPPI.

Erosion problems have also been noted at road stream crossings, along the banks of county drains, and natural waterways. Table 5-1 depicts that very little streambank stabilization is being done or planned within the Watershed. Waterways and stream crossings showing evidence of erosion should be identified and prioritized for stabilization. Stream erosion is a function of the water velocity and volume carried in the stream, as well as the stability of the stream. A geomorphology study will determine how stabilization efforts will affect reaches above and below the project site. If it is determined that stabilization is needed, a geomorphology study should be conducted prior to making any changes in the stream.

2005 UPDATE

Both Macomb and St. Clair Counties have developed a county-wide SESC ordinance that adopts the State's statute for their SESC programs.

PUBLIC EDUCATION GAP ANALYSIS

Training programs should be developed and implemented for municipal staff in the BMPs that affect storm water runoff. This training will help fulfill the communities' Phase II requirements. The type of education a municipality should provide to fulfill this requirement includes: fertilizer, pesticide, and herbicide application methods; illicit discharge detection and reporting; fleet maintenance; storage and disposal of hazardous materials; SESC; general storm water awareness; and land use planning.

2005 UPDATE

The Watershed's communities and counties established a Public Education Subcommittee to revise the 2003 PE Strategy and develop a Public Education Plan (PEP) template for all entities to use as a basis for their individual PEP commitments. This template and strategy not only helped communities fulfill permit requirements, but also helped them choose activities that are common across the Watershed.

INFRASTRUCTURE GAP ANALYSIS

In order to protect watercourses within the Watershed, increased inspection and maintenance of storm water control facilities is needed. In order to fill this gap, communities and counties need to assess storm water control programs and their funding sources to ensure they can be properly implemented.

Storm water ordinances are needed across the Watershed to ensure that proper infrastructure is built and storm water flows are managed. This is required as part of Phase II post-construction requirements. A storm water ordinance is a common method of meeting this requirement and can be developed by both the counties and local communities. Local communities could also refer to a county ordinance in their new construction specifications rather than developing their own ordinance.

Package treatment plants are also part of the Watershed infrastructure that needs increased planning, inspection, and maintenance. Currently, package treatment plants are permitted through the MDEQ with little or no consultation with local communities or the county. Local communities and the county should have input regarding the location, number, and amount of discharge permitted for each package treatment plant within each region and along each waterway on a cumulative basis.

2005 UPDATE

Macomb County has developed a model storm water ordinance to encourage the use of structural, vegetative, or managerial practices, designed to treat, prevent, or reduce degradation of water quality due to storm water runoff. Fishbeck, Thompson, Carr & Huber, Inc. developed a model ordinance for the entire Watershed that recommends certain design specifications for criteria of flood control, stream protection, water quality, spill protection, groundwater recharge, and LID.

HABITAT AND PLANNING GAP ANALYSIS

St. Clair County should join Macomb County in its efforts to initiate an MNFI. These inventories aid local communities in identifying riparian land for future parks and public access, areas where wetlands may be constructed for use as regional detention and flood control, or natural features, such as woodlands and wetlands.

Local communities that have identified natural features for protection should utilize land use planning tools to ensure their protection. A natural features ordinance, wetland ordinance, other types of ordinances, or modification of the site plan review process for natural resource and environmental protection is needed if these features are to be protected. For example, local communities that have identified farmland as a resource to be preserved should adopt an ordinance, like Richmond Township has, that will protect existing farmland and habitat areas while allowing development in prescribed township areas. In addition, comprehensive master plans should incorporate language regarding the need for natural features protection in order to support community ordinances, policies, and practices. At a minimum, water resources should be identified as a natural feature to protect.

Riparian land is one of the most important land areas that the communities and counties should protect, including the establishment of buffer zones for water quality protection. Managing riparian corridors has been identified as a gap in Table 5-1. Natural feature setbacks or overlay districts are examples of planning tools that can help protect these areas with natural vegetation buffers.

The lack of habitat restoration efforts is also identified as a gap across the Watershed. Bioengineering, natural plantings, tree cover, and log and bank shelters are some of the habitat improvement techniques that local communities can use on natural waterways and counties can use on drains.

2005 UPDATE

Macomb County developed model environmental ordinances through a series of workshops with governmental leaders and planners. The ordinances address storm water management, floodplains, wetlands, resource protection overlay, natural features setbacks, native vegetation, and woodlands and trees.

CHAPTER 6 - METHODS OF MEASURING PROGRESS

As stated in the original Anchor Bay Watershed Management Plan (WMP), watershed planning is a dynamic process that can be represented by the cycle depicted in Figure 6-1. The evaluation process is an important part of watershed planning that allows for a review of watershed conditions and impairments each time the evaluation is completed. It also establishes a mechanism for determining the success and usefulness of programs initiated within the watershed in response to problems defined in the planning process. A well planned evaluation process measures the effectiveness of the WMP by showing changes in the public's awareness of water quality issues, changes in attitudes or behavior, changes in conditions of the watershed, and improvements in water quality.

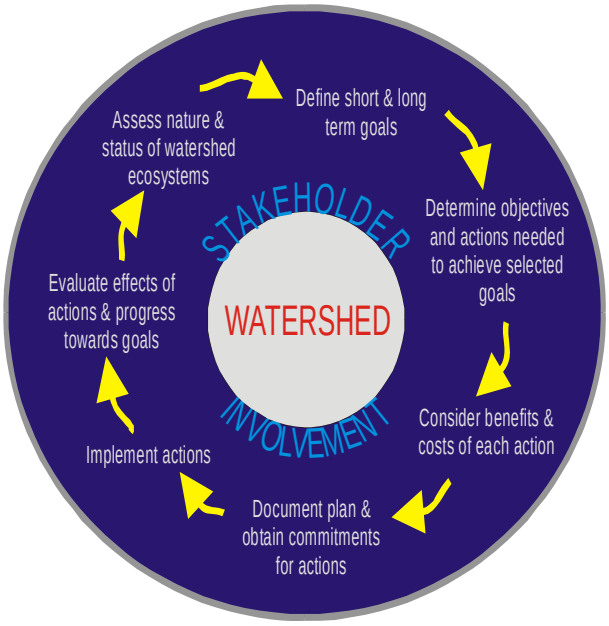

Figure 6-1: Evaluation Process as part of the Watershed Management Planning Cycle

Local counties, municipalities, and organizations within the watershed will do much of the evaluation. Certain environmental measurements, however, are best conducted by the Michigan Department of Environmental Quality (MDEQ) and/or the Michigan Department of Natural Resources.

The Anchor Bay Steering Committee (Steering Committee) is responsible for the development and implementation of an overall evaluation strategy of the WMP, tracking the progress and effectiveness of pollution prevention efforts as well as revising and updating the WMP. This responsibility, however, can only begin once the Steering Committee has developed into a sustainable organization. Therefore, the evaluation process will be started after a one-year period, during which contracts between the communities will be developed and agreements have been signed to work together to form a sustainable Steering Committee. The challenge for the Steering Committee is to determine whether the cumulative effect of these recommended implementation efforts are successful in meeting water quality standards in the watershed and achieving the goals of the WMP.

Since National Pollutant Discharge Elimination System (NPDES) Phase II communities must report progress on their pollution prevention activities to the MDEQ on an annual basis, the Steering Committee will use these annual reports to measure progress toward implementation of the WMP. A review of the implementation process, effectiveness of pollution prevention activities, and tracking of these activities will also be discussed in bi-annual (every 6 months) Steering Committee meetings. These meetings will aide in the WMP update and evaluation process, allowing for any necessary midstream corrections. For

non-Phase II communities, the Steering Committee will expect similar annual report cards and/or input into the evaluation process.

An evaluation of the implementation of the WMP will provide the Steering Committee an opportunity to assess the effectiveness of the activities that have been implemented to achieve the goals set forth in the WMP. This chapter expands on the evaluation methods developed in the 2003 WMP to describe the set of criteria, based on the milestones developed, that will be used to determine if the pollutant reductions are being achieved over time and if substantial progress is being made toward attaining water quality standards.

Criteria was established to determine whether the WMP needs to be revised if the pollution reductions are not being achieved or progress is not being made toward attaining water quality standards (WQS). The WMP would need to be revised if the milestones are not being met or the Best Management Practices (BMPs) being implemented are not adequately meeting the defined goal. If additional watershed concerns are discovered, the milestones, actions, and commitments would also need to be updated. Monitoring components are also described to evaluate the effectiveness of the implementation efforts over time, based on the criteria. The evaluation process is outlined in Tables 6-1, 6-2, and 6-3.

In Table 6-1, the process is organized by matching a monitoring component to each BMP recommended in Chapter 4, and then describing the criteria and milestones for measuring progress toward meeting the goals and objectives. The Anchor Bay Evaluation Subcommittee developed 2-year and 7-year milestones to determine whether the BMPs are being implemented and if the progress in meeting the goals is moving in the right direction. The parties responsible for working with the Steering Committee in evaluating the achievement of the milestones are also included in Table 6-1. The task of measuring progress is a necessary component of creating a dynamic and effective management plan for Anchor Bay. The evaluation criteria provide an indication of how BMPs can be assessed to evaluate success.

Table 6-2 describes the monitoring plan in terms of the agency or organization responsible for conducting the monitoring, the parameters to be monitored, potential funding to conduct the monitoring, and the method to communicate the results of the monitoring. Table 6-3 provides a timeline for watershed monitoring that would measure water quality and habitat improvements after BMPs and management strategies have been implemented. The monitoring efforts are grouped by organization and the parameters to be measured are described. Figure 6-2 presents a proposed monitoring regime, illustrating where the monitoring would occur. Table 6-4 identifies each sampling point as to what is being measured. Some criteria are more appropriate for measuring progress on a watershed-basis, such as public awareness surveys and fishery surveys. Other criteria are more appropriate for specific sites or small tributaries, such as pollutant reduction calculations or student monitoring results. Through this evaluation process, communities and agencies will be better informed about public response and success of the

project, what improvements are necessary to the project, and which BMPs to continue as part of the project.

NPDES Phase II municipalities, involved as members of the Steering Committee, are required to update the WMP every two years. The evaluation methods presented in this chapter will assist the Steering Committee in determining what parts of the WMP are in need of revision. The update ensures that the WMP remains relevant and is a working document that can be used effectively to guide the implementation of environment-related activities within the Watershed.

6.1 SUMMARY OF MONITORING COMPONENTS

Many parameters are currently being monitored in the Watershed. Some are conducted at a local level, while others are administrated at the county and state level. Establishing monitoring targets, against which observed measurements are compared, helps the Watershed group determine whether progress is being made toward targets and ultimately the Watershed goals. For some of the monitoring components, a firm target was set, such as "Inspect 90% of parks in critical *E. coli* areas twice a year," to compare what actual target is achieved to how close the implementation of the WMP is for that goal and objective. The targets set are not enforceable, just a measure that the Steering Committee can use to gauge the implementation efforts. Table 6-1 identifies the specific monitoring component to measure the effectiveness and success of each BMP recommended for this Watershed. Those specific monitoring components are described below. The monitoring components that will be used to measure the overall improvement in the Watershed are described afterwards.

6.2 SPECIFIC MONITORING COMPONENTS FOR RECOMMENDED BMPS

6.2.1 UNITED STATES DEPARTMENT OF AGRICULTURE - NATURAL RESOURCES CONSERVATION SERVICE (NRCS) YEARLY STATUS REVIEWS

The NRCS District Offices are required to report annually on the agricultural practices installed in that county under all Farm Bill programs. The Steering Committee will work with NRCS and the conservation districts to gather this information and track the practices and the resource concerns that they address to assess water quality impacts from agricultural operations.

6.2.2 POLLUTANT REDUCTION CALCULATIONS

The MDEQ provides instructions to calculate and document pollutant reduction from treatments to sources of sediment and nutrient pollutants using BMPs. The tons of sediment and associated pounds of nitrogen and phosphorus reduced from an identified site are calculated. The methods have standardized the progress reporting to systematically represent water quality impacts and statewide achievements of the amount of pollutants prevented from entering the waterways. The 3-year milestone is to identify the sites at which measurements need to be made to perform the pollutant reductions calculations.

The 8-year milestone is to perform the calculations and report them to MDEQ and Environmental Protection Agency. As BMPs are installed, the Steering Committee can calculate pollutant reductions to estimate the amount of pollutants prevented from entering the stream and also compare the cost of BMPs to the amount of pollutants reduced.

6.2.3 NPDES PHASE II ANNUAL REPORTS

Communities regulated under the NPDES Phase II storm water program are required to submit a report on the implementation status of the NPDES storm water permit and the progress and effectiveness of pollution prevention in their community on an annual basis. The reports must cover all of the decisions, actions, and results performed as part of the permit during the previous year.

- The progress report provides information of the actions taken to eliminate illicit discharges and evaluate the effectiveness of the program, as outlined in the approved Illicit Discharge Elimination Plan (IDEP).

- The community must provide documentation of the public education efforts and a summary of the evaluation of its effectiveness, as outlined in the approved Public Education Plan.

- The community must describe the compliance status of the permittee-specific actions and implementation schedules for the regulated areas, as outlined in the approved Storm Water Pollution Prevention Initiative (SWPPI). The reporting of SWPPI compliance status in the annual reports is expected to begin in 2006.

6.2.4 ST. CLAIR COUNTY DRAIN OFFICE (SCCDO)

The SCCDO conducts physical inventories and inspections of the county drains, when necessary or requested. Problems associated with soil erosion and sedimentation, high flows, habitat degradation, and agricultural practices impairing water quality are investigated.

6.2.5 SOIL EROSION AND SEDIMENTATION CONTROL (SESC) PROGRAMS

The St. Clair County Department of Public Works is the County Enforcing Agency (CEA) for the SESC Act 451, Part 91. The CEA is responsible for enforcing their SESC ordinance and administering SESC programs. The SCCDO and the St. Clair County Road Commission are Authorized Public Agencies (APA).

The Macomb County Public Works Office (MCPWO) is the CEA for Macomb County and responsible for administering the SESC ordinance. The Macomb County Road Commission is a registered APA.

6.2.6 NPDES IDEP

The Macomb County Health Department (MCHD), MCPWO, St. Clair County Health Department (SCCHD), and SCCDO received funding to complete an IDEP investigation, looking for failing onsite disposal systems, illegal dumping, and pollutants from municipal storm sewers. The Anchor Bay IDEP investigations are complete and 90% of all the identified problems have been corrected. Further investigations on homeowner septic systems will occur on a complaint basis until IDEP investigations are made throughout the entire county.

6.2.7 WASTEWATER TREATMENT PLANT AND INDUSTRIAL COMPLIANCE TESTING

Wastewater and industrial discharges are regulated under permits issued by the MDEQ. There are 16 permitted point source discharges that exist within the Watershed. These permittees are generally in compliance with discharge permits. The number of treated domestic wastewater discharges to the Watershed is increasing as more development occurs outside of the established sewer service area. The Steering Committee will review the reports submitted to the MDEQ and list the violations per year to assist in monitoring the improvements in the Watershed.

6.2.8 REVIEW OF COMMUNITY MASTER PLANS AND ORDINANCES

Macomb County is currently developing a SESC ordinance. St. Clair County has an SESC ordinance that does not go beyond state requirements. The Steering Committee will conduct a follow-up with the counties and communities to track the enforcement and effectiveness of the ordinance.

6.3 OVERALL WATERSHED MONITORING EFFORTS

The Steering Committee has developed a monitoring plan that will assess the cumulative effect of all the various implementation efforts. This plan is structured according to pollutants of concern and organizations responsible for conducting the monitoring, as described in Table 6-2.

6.3.1 PREVIOUS STUDIES

The Lake St. Clair Assessment Regional Monitoring Project (LSCA) was previously conducted as part of a 2.5 million dollar grant awarded to the Macomb County Health Department and will be used as a benchmark condition of the Watershed. The LSCA Project acquired streamflow and water and sediment quality data over the 2004 and 2005 sampling seasons, with emphasis on the effects of major storm events. As part of the overall project, water quality monitoring was conducted at 4 locations in the Anchor Bay Watershed: Swan Creek, Salt River, Beaubien Creek, and a tributary to Lake St. Clair. Samples at these locations were analyzed for numerous physical, chemical, and biological parameters. The results of the LSCA project will complete a more comprehensive assessment of water quality,

determine contaminant loadings to Lake St. Clair and its tributaries, characterize the relationship between sediment concentrations and water quality, better describe the impacts of land uses and subsequent stormwater runoff, and may identify currently unknown point source discharges. Currently, these data are being analyzed for preparation of a major report. Application of mathematical modeling and statistical analyses will lead to scientifically sound findings and conclusions about conditions of the Lake and its major tributaries. The results will be used for evaluating trends, analyzing the effectiveness of control measures and for decision making by local, state and federal policy makers.

6.3.2 MONITORING PLAN FOR BACTERIA

MDEQ had established a Total Maximum Daily Load for Salt River and Crapau Creek for *Escherichia Coli (E. coli)*. Loading allocation has been determined for the point source discharges in the Watershed. Reductions in inputs of *E. coli* to the Watershed can be determined through monitoring exceedances of those loads and the number of violations occurring. The WMP identified Salt River and Crapau Creek as critical areas for bacteria, since results of the monitoring indicate that they are exceeding WQS.

The MCHD currently performs surface water sampling of *E. coli* at eleven locations in the Salt and Crapau Creek Watersheds and several other sites in minor tributaries as part of the Weekly Watershed *E. coli* Monitoring Project. In places where a source of *E. coli* contamination appears to be entering a watercourse, the MCPWO and MCHD have initiated a more extensive investigation that includes additional sampling and dye testing. They also work with local municipalities to locate and eliminate pollution sources. The testing results are used to identify WQS violations.

MCHD has performed analysis on water quality through the LSCA project since 1998. The LSCA 2004 report found a statistically significant correlation (r = 0.78) between aqueous *E. coli* counts and turbidity at the Salt River (n28). This relationship was also found in last year's data. A statistically significant downward trend in *E. coli* was noted at Crapau Creek (n29) for the period of 1998 to 2004.

New Baltimore is the only public bathing beach in the Watershed and is monitored through the Macomb County Bathing Beach Monitoring Program. Macomb County is planning to continue funding all of the above sampling efforts.

Nine sites along the Anchor Bay shoreline are currently being monitored for *E. coli* weekly by the SCCHD. These sites are identified as: Tin Fish, Michigan Department of Natural Resources Boat Launch, Johnnie Lega's Pier, Brown's Landing, Frank's Dock, 1825 South Channel Drive, Algonac State Park, Marine City Dredge Cut, and Algonac Boardwalk. St. Clair County plans to continue this water quality monitoring program and is investigating adding Swan Creek and Beaubien Creek as additional sites for *E coli* monitoring.

A typical sampling regime of the Health Departments would consist of weekly sampling from the end of May to the beginning of September.

6.3.2.1 Bacteria Criteria

The criteria for *E. coli* will be based on WQS and attaining designated uses. The targets set for *E. coli* are for water bodies to meet water quality standards for total and partial body contact recreation. Total body contact recreation standards are set by the State of 130 count *E. coli* per 100 milliliter (ml) as a 30-day geometric mean from May 1 to October 31. Partial body contact recreation standards are set as 1,000 count *E. coli* as a 30-day geometric mean all year.

The results of the monitoring can determine if the trend is moving toward meeting WQS and the designated uses. A measurable decrease in the number of MCHD WQS violations for bacteria will indicate that trend. The 3-year milestone was determined to be a 50% decrease in the number of violations for bacteria. The 8-year milestone was set as a 75% decrease in the number of violations.

6.3.3 MONITORING PLAN FOR NUTRIENTS, DO, PH, WATER TEMPERATURE, AND METALS

The MCHD is completing the final report on the LSCA 2004 sampling results, which found the average annual nitrate concentration exceeded the critical value of 0.3 mg/L at the Salt River (n28), Crapau Creek (n2), and the South Channel (n13). However, statistically significant downward trends in nitrate, total phosphorous, chloride, total organic carbon, and E. coli were noted at Crapau Creek (n29) for the period of 1998 to 2004. Macomb County is planning to continue this project with funding from the Army Corps of Engineers and MDEQ.

The wastewater treatment plants in the Watershed regularly test raw water at their intakes for many water quality indicators, including ammonia nitrogen, total phosphorus, total residue chlorine, mercury, and copper. This sampling is conducted five times per week to comply with their NPDES discharge permits and will continue as long as they have their permits.

The operators and staff of the wastewater treatment plants (WWTPs) in New Baltimore and Algonac and the staff at Ira Water Treatment Plant (WTP) have offered to test for additional pollutants and accept samples from offsite to run through their analytical equipment. Staff from the New Baltimore WWTP will conduct monitoring at the Salt River, Crapau Creek, and Marsac Creek. They will measure DO and temperature in the field and drop samples off at Chesterfield Township for analyzation of bacteria, nutrients, and pH. Staff from the Algonac WWTP will collect similar monitoring on the Dana Drain, pending SCCPWO board approval. Algonac staff will conduct similar monitoring on the Marine City Dredge Cut and Ira Township WTP staff will collect similar monitoring on the Swan Creek and Beaubien Drain. The samples will be collected once a month for a year, every five years, as far upstream as possible where the water bodies have constant flow, but not the influence of Lake St. Clair.

6.3.3.1 Nutrient, DO, pH, Water Temperature, and Metals Criteria

Consistent with Great Lakes protection, the MDEQ states that limits for municipal wastewater discharges of phosphorus, "which is, or may readily become, available as a plant nutrient, shall be controlled from point source discharges to achieve 1 milligram (mg) per liter of total phosphorus as a maximum monthly average effluent concentration unless other limits, either higher or lower, are deemed necessary and appropriate. In addition, nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the surface waters of the state."

The criteria for nutrients are based on proposed WQS for phosphorus, a major nutrient for aquatic plant growth and often the limiting nutrient in freshwater systems. The results of the monitoring can determine if the trend is moving toward meeting WQS. MDEQ is expecting to present draft nutrient rules for surface water in the spring of 2006, with the rules going into effect in the fall of 2006. Proposed total phosphorus (TP) thresholds for lakes range from 0.01 mg/l to 0.027 mg/l. Proposed standards for streams have TP thresholds found at variable concentrations (0.01 to 0.80 mg/l), based on diatoms, macroinvertebrates, and fish productivities (http://www.epa.gov/r5water/wqb/presentations/holden.pdf). A measurable decrease in the number of WQS exceedances for phosphorus will indicate that trend. The 3-year milestone was determined to be a 50% decrease in the number of exceedances. The 8-year milestone was set as a 75% decrease in the number of exceedances.

The criteria for dissolved oxygen (DO), temperature, and pH are based on current water quality standards established by the State of Michigan. A minimum of 7 milligrams per liter (mg/l) of DO in all Great Lakes and connecting waterways shall be maintained at all times in all inland waters designated to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 mg/l of DO shall be maintained. The results of the monitoring in the field can determine if the WQS is being met at those locations. A reduction in the number of DO measurements exceeding WQS will indicate if the DO is suitable for the desired fisheries.

Rivers, streams, and impoundments naturally capable of supporting coldwater fish shall not receive a heat load which would do either of the following: (a) Increase the temperature of the receiving waters at the edge of the mixing zone more than 2 degrees Fahrenheit above the existing natural water temperature, (b) Increase the temperature of the receiving waters at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

J F M A M J J A S O N D

38 38 43 54 65 68 68 68 63 56 48 40

Rivers, streams, and impoundments naturally capable of supporting warmwater fish shall not receive a heat load which would warm the receiving water at the edge of the mixing zone more than 5 degrees Fahrenheit above the existing natural water temperature. Rivers, streams, and impoundments naturally capable of supporting warmwater fish shall not receive a heat load which would warm the receiving water at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

For rivers, streams, and impoundments south of a line between Bay City, Midland, Alma, and North Muskegon, except the St. Joseph River:

J F M A M J J A S O N D

41 40 50 63 76 84 85 85 79 68 55 43

The results of the monitoring in the field can determine if the WQS is being met at those locations. A reduction in the number of temperature measurements exceeding WQS will indicate if temperatures are suitable for the desired fisheries.

The hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 in all surface waters of the state, except for those waters where the background pH lies outside the range of 6.5 to 9.0. Any requests to artificially induce a pH change greater than 0.5 in surface waters where the background pH lies outside the range of 6.5 to 9.0, shall be considered by the department on a case-by-case basis. The results of the monitoring in the field can determine if the WQS is being met at those locations. A reduction in the number of pH measurements outside the range of WQS will indicate if the pH is suitable for the desired habitat.

6.3.4 MONITORING PLAN FOR SEDIMENT

The Algonac Regional WWTP and the New Baltimore WWTP currently test raw water intakes for many parameters, including total suspended solids, but not turbidity. This monitoring is required under their NPDES discharge permit and will therefore continue for the duration of their permit.

Volunteers performed a pebble count analysis at 10 sites during the monitoring for the hydrologic study in 2004. The Steering Committee will use information gathered from that analysis to conduct studies at those sites every five years, which would measure the extent to which the objects are covered by sediment and the changes to that coverage over time.

The GLEAS No. 51 sampling protocol, conducted by MDEQ, to establish a water quality rating can also include an embeddedness study to determine the amount of sediment in a stream system. The Steering Committee will submit a monitoring request to the MDEQ Water Bureau, Surface Water Assessment

Section (SWAS), for an embeddedness study to be conducted. This request will be made in the fall of 2007 for the 2008 monitoring season, and will continue to make this request every 5 years. These submittals will include recommendations on where the assessment and what type of assessment should be conducted. MDEQ could continue to provide training to volunteers on this method or other methods to measure sediment, either through SWAS or the Nonpoint Source Unit.

6.3.4.1 Sediment Criteria

According to EPA, "suspended and bedded sediments are defined as particulate organic and inorganic matter that suspend in or are carried by the water, and/or accumulate in a loose, unconsolidated form on the bottom of natural water bodies. This includes the frequently used terms of clean sediment, suspended sediment, total suspended solids, bedload, turbidity, or in common terms, dirt, soils or eroded materials." The State of Michigan uses an effluent limitation system, with numeric criteria of 30 mg/l as a daily concentration during June 1 through August 31, and 36 mg/l as a daily concentration from September 1 through May 31.

The criteria for sediment evaluation would be a decrease in the number of exceedances of TSS and TDS measured by the WWTPs, more sites having sedimentation consistent with the soils types, as rated through the pebble count, and a measurable increase in the water quality rating, as rated through the GLEAS No. 51 survey.

6.3.5 MONITORING PLAN FOR HABITATS

MDEQ Macroinvertebrate Monitoring

The MDEQ has developed a system to estimate the health of the predicted fish and macroinvertebrate communities through the GLEAS No. 51 sampling protocol. The State of Michigan conducts this protocol every 5 years in major watersheds and includes an assessment of the benthic macroinvertebrates. The MDEQ's next benthic survey is scheduled for 2008.

Freshwater benthic macroinvertebrates are animals without backbones that are larger than 0.5 millimeter (the size of a pencil dot). These animals live on rocks, logs, sediment, debris, and aquatic plants during some period in their life and include crustaceans, such as crayfish, mollusks, such as clams and snails, aquatic worms, and immature forms of aquatic insects, such as stonefly and mayfly nymphs. Benthic macroinvertebrates are an important part of the food chain, especially as prey for fish. Many feed on algae and bacteria, which are on the lower end of the food chain. Some shred and eat leaves and other organic matter that enters the water. Because of their abundance and position as middleman in the aquatic food chain, these organisms play a critical role in the natural flow of energy and nutrients. As these macroinvertebrates die, they decay, leaving behind nutrients that are reused by aquatic plants and

other animals in the food chain. When these macroinvertebrates are found in large quantities, the waters are generally classified as clean or unpolluted by organic wastes. Without too much organic matter, the waters usually have lots of oxygen. For example, stoneflies are often considered to be clean water organisms. But when thinking about worms and midges, water quality professionals often view these as indicators of dirty water, especially in rivers and streams. Many studies regarding benthic macroinvertebrates have been conducted in Lake St. Clair; however, little data exists for Anchor Bay's tributaries. Studies that provide information on macroinvertebrates in the Watershed, in addition to MDEQ's surveys, need to be conducted to determine a comprehensive understanding of aquatic life habitat conditions in the watershed.

MDEQ Stream Crossing Surveys

MDEQ also completes stream crossing surveys in each watershed on a five-year rotation and habitat is one component evaluated. The MDEQ stream crossing survey procedure was developed as a quick screening tool to assess general water quality and possible pollutant sources, causes, and problems within the Watershed. The survey procedure provides standardized visual assessments that can be conducted by MDEQ staff or trained volunteers. Because this assessment is based on visual observations designed to be conducted quickly, the survey results are only qualitative in nature. In addition, each site is photo-documented with a digital photograph taken in the downstream direction, upstream direction, and of the stream crossing. Examples of information collected at a site include: weather and any event conditions, culvert/bridge conditions, channel conditions, stream appearance, substrate composition, instream cover, stream corridor, and potential pollutant sources. The next MDEQ stream crossing surveys are scheduled in the Anchor Bay Watershed in 2007. The Steering Committee will continue to investigate the waterways in the Watershed and recommend to MDEQ what stations need to be surveyed in the future. One use for the surveys is to prioritize areas in the Watershed where water quality problems may exist. Certain areas would be identified for further investigation, to assess habitat conditions and streambank erosion. Other stretches could be assessed for improvements where BMPs were implemented.

GIS Monitoring Tools

Macomb and St. Clair County Geographic Information System (GIS) Departments are planning to conduct a land use-land cover analysis that would identify changes in impervious cover and habitat. This analysis could track the implementation effects of certain management and policy BMPs, such as buffer ordinances, and open space preservation, to determine habitat improvements as a result of these BMPs.

6.3.5.1 Habitat Criteria

The criteria for macroinvertebrates are based on the amount and diversity of species sampled in a biosurvey at a specific location. Following sample analyses, a macroinvertebrate score is calculated for each station based on the sum of nine metrics. Each metric score for an individual station is contrasted to the ecoregional excellent sites. A final biosurvey category describing the degree of similarity to the excellent sites is given each station based on the total metric point score calculated. The three year goal is to have a 50 % of the locations rated as similar to the ecoregion excellent site, and an eight year goal of having 80% of the sites rated as similar to the ecoregion excellent site.

The information is still incomplete for the road surveys, although the 2002-2003 resulted reported that 8% of the habitats were rated good, 59% of the habitats were rated as fair, and 33% of the habitats were rated as poor. The MDEQ and the Steering Committee could complete the inventory according to MDEQ protocol, and then reassess the results to prioritize the contribution of pollutants to the watershed. The criteria for habitat will be based on these road stream crossings, with a three-year goal of increasing the crossings rated as good to 15%, and an eight-year goal of increasing the crossings rated as good to 25%. The criteria for evaluating improvements of habitat based on the land use-land cover analysis will be determined during the development of the work plan for the project.

The criteria for the GIS tools of analyzing land use and land cover will be developed once the County has the program in place.

6.3.6 MONITORING PLAN FOR HYDROLOGY

A computer model was developed by Fishbeck, Thompson, Carr & Huber, Inc., in 2005, to assess the hydrologic conditions of a typical subwatershed under three build out scenarios to determine the most effective detention policies to protect the Anchor Bay Watershed streams from development-induced streambank erosion. The Steering Committee, if financial resources are available, will perform subsequent runs of the model previously developed when BMPs or strategies, recommended in the storm water ordinance, have been implemented.

Rainfall and stream monitoring was performed at reference reaches to support the regional curve analysis and the hydrologic modeling analysis. If one or more rainfall events occur that produce near bankfull flows, then the rainfall monitoring data can be used to determine the frequency of the bankfull event. The Steering Committee could take measurements at the reference reaches in 5 years to assess the condition of the reaches to see if the storm water management practices have protected these areas from the effects of increased flow. Volunteers could measure the cross-sections of the streams, velocities, flows with a pygmy meter, and rainfall from rain gauges to look for changes that might have occurred due to build out. The rain gauges and flow measurements make it possible to measure the frequency of bankfull

flows, to see if the flows have increased in response to similar rainfalls in the past. Actual measurements of stream sections and discharges associated with a measured rainfall event can be used to calibrate the hydrologic model to actual conditions. The model could then illustrate if the practices and management strategies adopted have reduced peak flows and addressed the high-flow issues associated with water quality impairments, as predicted in the initial model.

6.3.6.1 Hydrology Criteria

The criteria for assessing flow will be to use the hydrologic model and the flow measurements to determine the effects of build out and what might have happened if the storm water management practices had not been put in place.

6.4 Conclusion

Ultimately, the Steering Committee will use all of these monitoring efforts to gain an understanding of the overall progress toward meeting water quality standards and achieving pollutant loading reductions. The Steering Committee will determine the costs of the methods to determine the most effective strategy to perform this evaluation and has agreed to allocate costs of future evaluation efforts among group members.

TABLE 6-1: GOAL 1 - RESTORE AND ENHANCE RECREATIONAL USES

Actions and Best Management Practices (No.)	Monitoring Components	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Partners
OBJECTIVE: Reduce bacterial loading							
Develop manure management plans and CNMPs (part of GAAMPs (No.1)	USDA yearly status reviews	Number and location of agricultural BMPs installed	Increased participation in Farm Bill programs	Identify agricultural operations in need of manure management plans and CNMPs	Develop 75% of manure management plans and CNMPs needed	Annually	**Conduct Monitoring:** NRCS **Implement Evaluation:** Steering Committee, Conservation Districts
Control SSOs and maintain sanitary sewer infrastructure (No.2)	NPDES Phase II Annual Reports	Number of SSOs reported	Elimination or control of SSOs	Identify areas with potential SSOs	Watershed in full compliance with Part 41, Sewerage System permits and agreements	Annually	**Conduct Monitoring:** MDEQ, New Baltimore Wastewater Treatment Plant **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Eliminate failing OSDSs (No.3)	NPDES Phase II Annual Reports	Number of failing OSDS reported in St. Clair County	Elimination or control of OSDS failures	Increase or maintain ability to enforce the correction of OSDS failures	Eliminate 90% of failing OSDSs	Annually	**Conduct Monitoring:** St. Clair County Health Department **Implement Evaluation:** Steering Committee, NPDES Phase II Entities in St. Clair County
		Number of systems identified through MC Ordinance	Enforcement of MC Ordinance	Increased identification of failing septic systems through MC Ordinance	Replace 100% of failing septic systems identified through MC Ordinance	Annually	**Conduct Monitoring:** MCHD **Implement Evaluation:** Steering Committee, NPDES Phase II Entities in Macomb County
Manage lagoon systems and package WWTP (No.4)	NPDES WWTP permit compliance	Number of permit violations	Decrease in number of permit violations	Identify permittees with discharges in Watershed	100% compliance with permit	Monthly	**Conduct Monitoring:** WWTPs **Implement Evaluation:** Steering Committee

TABLE 6-1: GOAL 1 - RESTORE AND ENHANCE RECREATIONAL USES

Actions and Best Management Practices (No.)	Monitoring Components	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Partners
Manage pet waste and wildlife populations (No.5)	NPDES Phase II Annual Reports	Number of pet waste information stations with bags to collect waste	Number of bag refills	Identify popular riparian areas for dog walkers	Install 5 pet waste stations	Annually	**Conduct Monitoring:** County and local parks **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
	Municipal inspections	Amount of pet waste	Opinion on whether the amount of dog waste has dropped at local parks	Develop inspection report and assess existing conditions	Inspect parks in critical *E. coli* areas	During regular maintenance duties; summary 1x/ year	**Conduct Monitoring:** Local Parks Departments **Implement Evaluation:** Steering Committee
	Wildlife population surveys	Population numbers of wildlife	Number of controls for wildlife populations	Identify critical riparian areas with concentrations of wildlife	Implement wildlife populations controls in critical riparian areas	Annually	**Conduct Monitoring:** Michigan Department of Natural Resources **Implement Evaluation:** NPDES Phase II Entities
OBJECTIVE: Reduce nutrient loading							
Support environmentally friendly lawn and garden maintenance (No.6)	NPDES Phase II Annual Reports	Environmentally friendly lawn and garden management practices	Increase in number of practices implemented and participants attending workshops	Development of environmentally friendly lawn and garden management practice training for local municipalities and counties at their facilities and parks and the general public	One practice installed at every park. Increase in number of participants and one additional program implemented every year	Annually	**Conduct Monitoring:** NPDES Phase II Entities **Implement Evaluation:** Steering Committee

TABLE 6-1: GOAL 2 - RESTORE AND PROTECT AQUATIC LIFE, WILDLIFE, AND HABITAT

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
OBJECTIVE: Provide additional public access to water resources							
Identify riparian land areas for recreation enhancement and conserve for future parks and public access (No.7)	Planning Department Annual Reports	Acres enhanced or conserved for public access sites	Increased number of acres enhanced or conserved for recreation	Identify riparian areas where recreational opportunities could be enhanced and establish and prioritize efforts to acquire and protect riparian land	Enhancement or acquisition of top 3 priority riparian lands	Annually	**Conduct Monitoring:** County parks and recreation, county planning departments, local municipalities and counties **Implement Evaluation:** Steering Committee
OBJECTIVE: Protect and re-establish riparian and instream habitat							
Install buffers and protect riparian corridors (No.8)	Planning Departments Phase II Annual Reports	Acres of protected riparian areas and riparian areas with adequate buffers	Acres of adequately protected riparian areas	Map priority riparian areas for protection	25% increase in number of riparian areas with adequate protection/buffer	Annually	**Conduct Monitoring:** State, county, and local planning departments **Implement Evaluation:** Steering Committee
Install storm drain markers (No.9)	NPDES Phase II Annual Reports	Number of storm drain markers installed	Percent of catch basins with storm drain markers	Identify and prioritize catch basins to have storm drain markers installed	Install 75% of total number of storm drain markers on catch basins	Annually	**Conduct Monitoring:** NPDES Phase II Entities PEP **Implement Evaluation:** Steering Committee
Utilize habitat restoration techniques (No.10)	MDEQ Stream Crossing surveys	Habitat site rating	Improved habitat site rating	Identify sites for habitat restoration efforts	Implement techniques at 3 sites for habitat restoration	Every 10 years	**Conduct Monitoring:** Road Commissions, Local municipalities **Implement Evaluation:** Steering Committee
Install/maintain oil and grease trap devices (No.11)	NPDES Phase II Annual Reports	Number of devices	Removal of oil and grease from storm water runoff	Identification of areas where installation would be beneficial	75% of devices installed in areas previously identified	Annually	**Conduct Monitoring:** Counties and local department of public works **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Minimize the effects of salt and deicing chemical storage areas (No.12)	NPDES Phase II Annual Reports	Number of properly stored salt and deicer chemicals	Properly stored salt and deicer chemicals	Locate storage areas	Inspect 100% of storage areas for compliance	Annually	**Conduct Monitoring:** County and Local departments of public works **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
OBJECTIVE: Reduce soil erosion and sedimentation							

TABLE 6-1: GOAL 2 - RESTORE AND PROTECT AQUATIC LIFE, WILDLIFE, AND HABITAT

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
Improve SESC programs (No.13)	NPDES Phase II Annual Reports	SESC programs	Reduction of erosion and sedimentation from construction sites	Develop plan to improve SESC program	Demonstrate progress on 2008 SESC improvement plan	Annually	**Conduct Monitoring:** Macomb and St. Clair SESC CEAs, SESC Municipal Enforcing Agents (MEAs) **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
	NPDES Phase II Annual Reports	Number of code enforcement actions per number of permits issued	Reduction in number of projects in violation	25% decrease in number of code enforcement actions per number of permits issued	Less than 10% of projects in violation	Annually	**Conduct Monitoring:** Macomb and St. Clair SESC CEAs, SESC MEAs **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Implement streambank stabilization measures (No.14)	Embeddedness study	Amount of sediment	Reduction of sediment	Identify most critical erosion sites and possible sources	Implement actions at 50% of critical sites to stabilize stream flows and/ or areas of erosion	After installation of system of BMPs	**Conduct Monitoring:** MDEQ, volunteers **Implement Evaluation:** Steering Committee
Perform street sweeping (No.15)	NPDES Phase II Annual Reports	Effectiveness of street sweeping program	Street sweeping strategy for maximum effectiveness	Identify entities that use street sweepers and evaluate components of program	2 additional entities using street sweepers and improved effectiveness	Every 2 years	**Conduct Monitoring:** County and local department of public works **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
OBJECTIVE: Reduce excess runoff							
Support environmentally-friendly lawn and garden maintenance (See No.6 above)							
OBJECTIVE: Protect open space and natural areas within the Watershed							
Conduct natural feature inventory and assessments (No.16)	NPDES Phase II Annual Reports	Natural features maps	Implementation of ordinances and overlay districts to protect water features and riparian land	Map and prioritize natural features without protection	Develop ordinances or overlay districts to protect identified areas	Annually	**Conduct Monitoring:** County and local planning departments **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Increase wetland conservation (No.17)	NPDES Phase II Annual Reports	Wetlands inventory - Inventory of unique wetlands unprotected by MDEQ	Implementation of programs that Increase protection of wetlands	Presentations regarding wetland conservation credits and wetland banking	Implement program to provide additional protection to wetlands	Annually	**Conduct Monitoring:** MDEQ, and local planning departments **Implement Evaluation:** Steering Committee, NPDES Phase II Entities

TABLE 6-1: GOAL 2 - RESTORE AND PROTECT AQUATIC LIFE, WILDLIFE, AND HABITAT

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
Implement natural features and floodplain protection ordinances (No.18)	NPDES Phase II Annual Reports	Natural features and floodplain protection ordinances	Implementation of ordinances	Develop model natural features and floodplain protection ordinances and present to county and municipal governments	Adopt ordinances or overlay districts to protect identified areas	Annually	**Conduct Monitoring:** County and local planning departments **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Continue and expand litter and debris cleanup programs (No.19)	NPDES Phase II Annual Reports	Number of cleanup programs	Increase number of programs	Identify areas in need of cleanup efforts	Conduct clean-up efforts in 5 areas	Annually	**Conduct Monitoring:** Local volunteer groups and organizations, Road Commission and MDOT Adopt-A-Road program PEP **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Continue and expand hazardous waste recycling programs (No.20)	NPDES Phase II Annual Reports	Level of participation in hazardous waste collection programs	Increase knowledge and use of hazardous waste collection	Increase hazardous waste education efforts	Increased hazardous waste collection knowledge and use by 25%	5 years (post Southeast Michigan Council of Governments education survey)	**Conduct Monitoring:** Local municipalities and counties **Implement Evaluation:** NPDES Phase II Entities

TABLE 6-1: GOAL 3 - PROTECT PUBLIC HEALTH

Actions and Best Management Practices (No.)	Monitoring Component	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
OBJECTIVE: Protect drinking water supply							
Include drinking water protection measures in master plans, zoning ordinances, and protection plans for the Cities of Algonac and New Baltimore and Ira Township (No.21)	Review of master plans and ordinances	Master plans and ordinances	Adoption of ordinances to support master plans	Complete (source water protection plans) and implement recommendations that have been approved by MDEQ	Complete evaluation of implementation efforts and review source water protection requirements	Every 5 years	**Conduct Monitoring:** City of Algonac, City of New Baltimore, Ira Township **Implement Evaluation:** Steering Committee
OBJECTIVE: Reduce pollutants resulting in fish advisories							
Hazardous waste recycling programs (See No.20 above)							
Identify and eliminate illicit discharges (No.22)	NPDES Phase II Annual Reports	Number of correction of illicit discharges/ connections	Correction of illicit connections	Correct illicit connections discovered through IDEP	Maintain an effective program for finding and eliminating illicit discharges	According to approved NPDES Phase II IDEP	**Conduct Monitoring:** County departments of public works and health departments **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
OBJECTIVE: Reduce bacterial loading							
Develop manure management plans (part of GAAMPs) (See No. 1 above)							
Control Sanitary Sewer Overflows (SSOs) and maintain sanitary sewer infrastructure (See No. 2 above)							
Eliminate failing onsite septic disposal systems OSDSs (See No. 3 above)							
Manage lagoon systems and package WWTP (See No. 4 above)							
Manage pet waste and wildlife populations (See No. 5 above)							

TABLE 6-1: GOAL 4 - REDUCE IMPACTS FROM PEAK FLOWS

Actions and Best Management Practices	Monitoring Component	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
OBJECTIVE: Establish target peak flows for tributaries							
Conduct hydrologic analysis (No.23)	Hydrologic analysis	Hydrographs	Storm water controls that protect target peak flows	Determine areas where target peak flows are needed within watershed	Implement storm water controls in identified areas to meet target peak flows	To be determined after entities have implemented storm water controls	**Conduct Monitoring:** Consultant **Implement Evaluation:** Steering Committee
OBJECTIVE: Develop water resource protection and management ordinances to reduce runoff							
Implement storm water ordinances that include low impact development techniques (No.24)	NPDES Phase II Annual Reports	Progress of NPDES Phase II Program	Adoption of ordinances and/or engineering standards	Progess towards adoption of model storm water ordinance and/or engineering standards	100% of Phase II entities adopt storm water ordinances	Annually	**Conduct Monitoring:** County and local planning departments **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
OBJECTIVE: Reduce storm water runoff quantity and minimize post-storm instream velocities							
Construct/maintain storm water storage facilities (No.25)	NPDES Phase II Annual Reports	Progress of NPDES Phase II Program	Installation of storm water control measures in developing areas	Identify areas from hydrologic model and build-out analysis where storm water control measures need retrofitting	50% of retrofit control measures implemented in identified areas	Annually	**Conduct Monitoring:** County and local departments of public works **Implement Evaluation:** Steering Committee, NPDES Phase II Entities
Install/maintain storm water infiltration devices (No.26)							
Enhance storm water treatment (No.27)							
Prevent and remove flow obstructions following woody debris management techniques (No.28)	Drain Commissioners' inspection reports	Amount of obstructions removed	Obstructions removed in critical areas	Identify critical areas for obstructions and develop maintenance plan	Implement maintenance plan	Annually	**Conduct Monitoring:** County and local departments of public works, drain commissioners **Implement Evaluation:** Steering

TABLE 6-1: GOAL 4 - REDUCE IMPACTS FROM PEAK FLOWS

Actions and Best Management Practices	Monitoring Component	Units of Measurement	Criteria	3-Year Milestone (2008)	8-Year Milestone (2013)	Evaluation Schedule	Responsible Parties
							Committee, NPDES Phase II Entities

Notes:
CNMPs - Comprehensive nutrient management plans
GAAMPS - Generally Accepted Agricultural Management Practices
SSOs - Sanitary Sewer Overflow
OSDSs - Onsite Septic Disposal Systems
USDA - U.S. Department of Agriculture
BMPs - Best Management Practices
MC - Macomb County Time-of-Sale Ordinance
NRCS - Natural Resource Conservation Service
MDEQ - Michigan Department of Environmental Quality
NPDES - National Pollutant Discharge Elimination System
MCHD - Macomb County Health Department
WWTP - Water Treatment Plant
SESC - Soil Erosion Sedimentation Control
CEAs - County Enforcing Agents
MEAs - Municipal Enforcing Agents

Table 6-2: Recommended Monitoring Plan for Anchor Bay Watershed

Organization	Name of monitoring program	Funding source	Dates of monitoring program	Locations of monitoring (within Anchor Bay Watershed)	Frequency of sampling	Parameters analyzed	Methods of evaluation	Summary of results (please attach report summary if possible)	Method to communicate results	Continuing efforts of program	Partners involved in program
County Activities											
Macomb County Health Department	Weekly Watershed *E. coli* Monitoring	Macomb County	May - September 1995 - present	11 sites in Crapau Creek, Salt River, and other minor tributaries	1 sample per site per week	*E. coli*	Total body contact standards	Salt River and Crapau Creek exceeding total body contact standards	www.macombcountymi.gov/publichealth	Will continue in future with County funding	
Macomb County Health Department	Bathing Beach Monitoring	Macomb County and State	May - September 1995 - present	New Baltimore Beach	3 samples per site per visit. Mondays and Wednesdays, mid-April to end of September	*E. coli*	Macomb County lab. Geometric mean in estimating a 30-day average from individual samples taken during five or more sampling events	Beach is closed in total body contact standards are exceeded -300 e. coli colonies per 100 milliliters, as a geometric mean of all samples collected at a beach during one sample event; -130 e. coli colonies per 100 milliliters, as a geometric mean of all samples collected over a 30-day period.	www.macombcountymi.gov/publichealth www.lakestclairdata.net Data from 2001-2005 on website, daily and 30-day geometric means posted	Will continue through County and State funding	
Macomb County Health Department	Lake St. Clair Assessment (LSCA)	Army Corps of Engineers, MDEQ, County	May - September 1998 - present	40+ locations near shore, off shore and within watershed of Lake St. Clair	Various	Water and sediment sampling for many parameters	Various		Comprehensive written reports, summaries, and additional informaiton on the website www.lakestclairdata.net	Will continue in future	
St. Clair County Health Department	SCCHD Weekly Monitoring Program	SCCHD	Late May - August 1995 - 2005	10 sites Marine City Dredge Cut St. Clair River Algonac State park Algonac Boardwalk Harsen's Island 1825 S. Channel Drive Frank's Dock North Channel - Browns Landing Beuabien Creek Swan Creek Anchor Bay - DNR Boat Launch - Tin Fish	Weekly	Bacteria	Full body contact standards	Overall meeting WQS for full body contact recreation	Written annual reports	Expected to continue	none

Table 6-2: Recommended Monitoring Plan for Anchor Bay Watershed

Organization	Name of monitoring program	Funding source	Dates of monitoring program	Locations of monitoring (within Anchor Bay Watershed)	Frequency of sampling	Parameters analyzed	Methods of evaluation	Summary of results (please attach report summary if possible)	Method to communicate results	Continuing efforts of program	Partners involved in program
Macomb County, St. Clair County GIS	Land use/Land Cover Analysis	Counties	2010 -	Entire Watershed	Every 5 years	Land use/Land Cover, habitat	Compare amounts of agricultural land and other changes in land cover	Look for new development to see effects of imperviousness and implementation of BMPS	Maps and report to communities, posted on website		1) SEMCOG
Water Treatment Plant Activities											
St. Clair County Waste Treatment Plants	NPDES Permit Compliance	St. Clair County Public Works Office, City of Algonac, Ira Twp, and Clay Twp.	Year round	Dana Drain (Swartout Creek)	Various	TSS, DSS, everything except turbidity and fecal - same as New Baltimore	The Steering Committee will evaluate data against criteria established by the state or otherwise by this WMP.	Look for concentrations close to criteria	Annual report to the Steering Committee.	Will continue for NPDES permitting	1) St. Clair County Public Works Office, 2) City of Algonac, 3) Ira Twp, 4) Clay Twp.
City of New Baltimore WWTP	NPDES Discharge Permit Compliance (MI0023680)	City of New Baltimore	Continuous	Outfall 001 - discharge to Crapau Creek 3 storm water stations on tributaries to Crapau Creek 67 sampling points for bacteria in Crapeau Creek from previous study	5 times per week (mercury and copper quarterly)	$CBOD_5$, ammonia nitrogen (as N), TSS, total phosphorus, (as P), total residue chlorine, mercury, copper, pH, flow	Maximum limits Multi-parameter probes installed on site	Criteria are determined by NPDES permit.	Summary of data included on City Council reports every month	Will continue for NPDES permitting	1) City of New Baltimore WWTP
Water Treatment Plants	Lake St. Clair and St. Clair River Drinking Water Monitoring System	Stakeholders of system		3 of 9 WTP sites in total project are located in the Anchor Bay Watershed: 1) City of New Baltimore 2) Ira Township 30 City of Algonac	Sampling to begin in 2007 The WTP hopes to provide the Steering Committee with sample processing or mobile probes once the project is set up.	Multi-parameter probes with mass spectrometers, florameters, testing for pH, alkalinity, VOCs, hydrocarbons, conductivity, DO	The Steering Committee will evaluate data against criteria established by the state or otherwise by this WMP.	Look for concentrations close to criteria	To be determined, possibly through a regional website	Funding was approved on 4/1/2006	Water Treatment Plants 1) City of New Baltimore 2) Ira Township 30 City of Algonac

Table 6-2: Recommended Monitoring Plan for Anchor Bay Watershed

Organization	Name of monitoring program	Funding source	Dates of monitoring program	Locations of monitoring (within Anchor Bay Watershed)	Frequency of sampling	Parameters analyzed	Methods of evaluation	Summary of results (please attach report summary if possible)	Method to communicate results	Continuing efforts of program	Partners involved in program
Anchor Bay Steering Committee Activities											
Anchor Bay Steering Committee (Staff from Ira Township DPW, Algonac WWTP, New Baltimore WTP and Chesterfield Twp.)	Anchor Bay Monitoring Program	Phase II MS4s and WQ Monitoring grants. Estimated consultant costs - 10,500 for sampling time, equipment, and analysis every 5 years	2007; Every five years thereafter.	1) Marine City Drain, 2) Swan Creek, 3) Beaubien Drain 4) Dana Drain (Swartout Creek) 5) Salt River 6) Crapau Creek 7) Marsac Creek - as far upstream as possible where year round water levels are present	Once every 5 years, 12-15 samples per site	Bacteria, nutrients (phosphorus), temperature, DO, and pH	Grab samples analyzed by local WWTPs Criteria established by the WMP.	Look for concentrations close to criteria	Written and electronic report for posting on the Anchor Bay website and other related project websites. Correlate with Lake sampling	SCCPWO sampling is dependent upon approval by their board. Costs of hiring a consultant to be allocated among Steering Committee	SCCPWO, Ira Twp, City of Algonac , City of New Baltimore, Chesterfield Twp., Consultant
											Ira Township Staff, Algonac WWTP, New Baltimore CWTP
Anchor Bay Steering Committee (volunteer field staff from MS4s and/or volunteer organizations)	Anchor Bay Monitoring Program	MS4s, WQ Monitoring grants Estimated consultant costs - $3,000 for each sampling period	2007 ; Every year thereafter.	Same sites as monitored in the 2004 hydrologic study Project and/or determined based on land use changes/ projects.	Once a year, and additional sampling during wet weather.	Sedimentation,	Embeddedness and/or pebble counts (whichever is more appropriate)	Criteria established in the WMP	Written and electronic report for posting on the Anchor Bay website and other related project websites.	Consultant costs to be allocated among the Steering Committee	MS4s – field staff, MSUE Adopt-a-Stream, Home School Association, Local Schools, SCC River Day, MDEQ provide training
Anchor Bay Steering Committee	Anchor Bay Monitoring Program	MS4s and/or grants Estimated Costs - $9,800 for time and analysis every 5 years	2010	Same as previous sites used for 2004 hydrologic study	Once every 5 years	Hydrology	Measurements at reference reaches	Compare to desired levels established in 2004 Report	Written and electronic report for posting on the Anchor Bay website and other related project websites.	Consultant costs to be allocated among the Steering Committee	Consultant, MDEQ, MS4s – field staff

Table 6-2: Recommended Monitoring Plan for Anchor Bay Watershed

Organization	Name of monitoring program	Funding source	Dates of monitoring program	Locations of monitoring (within Anchor Bay Watershed)	Frequency of sampling	Parameters analyzed	Methods of evaluation	Summary of results (please attach report summary if possible)	Method to communicate results	Continuing efforts of program	Partners involved in program
MDEQ Activities											
MDEQ - WB	MDEQ Road Stream Crossing Surveys	MDEQ - WB	2002; 2007; Every five years	24 Mile Road (Salt River), 27 Mile Road (Salt River), Shook Drain (Salt River) These are the 2002 Road Stream Crossing sites, different sites will be requested if necessary.	Every 5 years, 1 sample per site	Habitat metrics (substrate and instream cover, channel morphology, riparian and bank structure), temperature, flow, macroinvertebrates	Ratings	In 2002-2003, 8% rated good, 59% fair, 33% poor	MDEQ publishes report	Scheduled for 2007	MDEQ
MDEQ - WB	SWAS Watershed Monitoring Program	MDEQ - WB	Every five years		2002; 2007; Every 5 years	Road crossing conditions, stream and riparian habitat	Ratings	Habitat rating: Salt River - Marginal (moderately impaired) Shook Drain - Good (slightly impaired) Macroinvertebrate community rating: All Acceptable	MDEQ publishes report, available on website	Scheduled for 2007	Volunteers trained by MDEQ
MDEQ - WB	GLEAS Procedure 51 Water Quality Monitoring Program	MDEQ - WB	Request monitoring of MDEQ in October of year when monitoring is needed; 10/2008	Where requested	As requested	What's requested	How requested		MDEQ SWAS reports	Sampling is dependent on available MDEQ staff and MDEQ monitoring priorities.	Steering Committee

Table 6-3: Timeline Monitoring

	2007				2008				2009				2010				2011				2012			
Description	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**
Revise WMP				X								X								X				
Revise SWPPI						X								X								X		
COUNTY ACTIVITIES																								
Macomb County Health Department 11 sites	Weekly *E. coli* monitoring at 11 sites																							
Macomb County Health Department New Baltimore Beach		Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring		
Macomb County Health Department Lake St. Clair Assessment	Water and sediment sampling, near shore, off shore, and in lake																							
St. Clair County Health Department 11 sites		Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring				Bathing Beach *E. coli* Monitoring		
Macomb and St. Clair County GIS Entire watershed													Land Use/Land Cover Analysis											
WATER TREATMENT PLANT ACTIVITIES																								
St. Clair County Public Works Office																								
City of New Baltimore WWTP	NPDES Permit compliance testing for various parameters (ammonia, phosphorus, TSS, pH, flow)																							
Regional Water Treatment Plants	NPDES Permit compliance testing for various parameters (ammonia, phosphorus, TSS, pH, flow)																							
ANCHOR BAY STEERING COMMITTEE ACTIVITIES																								
Staff from Ira Township DPW and Algonac WWTP - Marine City Drain, Swan Creek, Beaubien Drain, Dana Drain		Grab samples for bacteria, nutrients, phosphorus, temp, DO, pH																				Grab samples for bacteria, nutrients, phosphorus, temp, DO, pH		
Staff from New Baltimore WWTP Salt River, Crapau Creek, Marsac Creek		Grab samples for bacteria, nutrients, phosphorus, temp, DO, pH																				Grab samples for bacteria, nutrients, phosphorus, temp, DO, pH		
Steering Committee Volunteers 10 sites, conducting pebble counts and embeddedness study		TSS				TSS				TSS				TSS				TSS				TSS		
Steering Committee and Consultant Hydrologic model and reference reach analysis													Hydrologic and reference reach analysis											
MDEQ ACTIVITIES																								
SWAS Watershed Monitoring 3 sites in Salt River								HM																
MDEQ Stream Crossing Surveys Complete survey in entire watershed based on 2002-2003 results		HM																						
GLEAS Procedure 51, as requested												WC												

Notes:

WMP = Watershed Management Plan
SWPPI = Storm Water Pollution Prevention Initiative
WWTP = Wastewater Treatment Plant
DPW = Department of Public Works
MDEQ = Michigan Department of Environmental Quality
SWAS = Surface Water Assessment Section

E. coli = *Escherichia Coli*
TSS = Total Suspended Solids
DO = Dissolved Oxygen
pH = potential of hydrogenBa measure of acidity and alkalinity
HM = Habitat Metrics
WC = Water Chemistry

Table 6-4: Sampling Points

Subwatershed	sample point	*E. coli*	TSS	TDS	$CBOD_5$	ammonia	total phosphorus	chlorine	mercury	copper	pH	flow	stream morphology	rain gauge	flow monitor	Habitat metrics	temp	macroinvetebrates	sedimentation (pebble counts, embeddedness)	VOCs	alkalinity	hydrocarbons	conductivitiy	DO
Anchor Bay Shores Drainage	ABS1	X																						
Pitts Drain	PD1	X																						
Salt River	SR1	X																						
	SR2	X					X				X						X							X
	SR3											X				X	X	X						
	SR4	X																						
	SR5												X											
	SR6											X				X	X	X						
	SR7											X				X	X	X						
	SR8	X											X						X					
	SR9												X		X				X					
	SR10													X										
Crapau Creek	CC1	X																						
	CC2	X	X	X	X	X	X	X	X	X	X	X	X				X			X	X	X	X	X
	CC3	X																						
	CC4	X																						
Marsac Creek	MC1	X																						
	MC2	X																						
	MC3	X					X				X				X		X		X					X
	MC4												X											
	MC5												X						X					
	MC6												X						X					
	MC7													X										
Swan Creek	SC1	X																						
	SC2	X					X				X		X				X							X
	SC3												X						X					
	SC4														X				X					
	SC5													X										
	SC6												X						X					
	SC7												X						X					
Beaubien Creek	BC1	X																						
	BC2	X					X				X						X							X
	BC3												X											
	BC4												X											
Swartout Drain	SD1	X																						
	SD2	X																						
	SD3		X	X	X	X	X	X	X	X	X	X								X	X	X	X	X
	SD4												X						X					
	SD5												X						X					
	SD6	X																						

Table 6-4: Sampling Points

Subwatershed	sample point	*E. coli*	TSS	TDS	$CBOD_5$	ammonia	total phosphorus	chlorine	mercury	copper	pH	flow	stream morphology	rain gauge	flow monitor	Habitat metrics	temp	macroinvetebrates	sedimentation (pebble counts, embeddedness)	VOCs	alkalinity	hydrocarbons	conductivitiy	DO
St. Clair River Drainage	SCR1	X																						
Marine City Drain	MCD1	X					X				X						X							X
South Channel Drive	SCD1	X																						
Frank's Dock	FD1	X																						
Brown's Landing	BL1	X																						
Other Water Treatment Plants																				X	X	X	X	X

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